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FOG DISPERSION.

So far as we know, there has been no practical application of the method proposed by Sir Oliver Lodge for dispersing fogs by electrical discharges. Sir Oliver used static machines for supplying the high voltage, and the difficulty of transmitting such high-voltage current throughout the streets of a city was apparently one of the greatest drawbacks to the proposed scheme. M. A. Breyden has made a study of this matter, and he proposes a modification which would seem to reduce the item of expense and make the system more practicable. He has found that high-voltage alternating currents are just as satisfactory for fog dispersion as the direct current furnished by a static machine. He suggests that lamp-posts be supplied with proper dispersion points, and the voltage supplied there by a small step-up transformer, itself supplied from the commercial alternating-current circuit. One terminal of the transformer should, of course, be connected to the dispersing arrangement, and the other may be connected to the ground, or, better, to a similar disperser placed some distance away. The expense of such a system would not be very great, and there would be little difficulty in installing it. For places frequently afflicted with fogs, a system of this kind would be of the utmost value. It would not be necessary to attempt to precipitate the fog of an entire city, but the main highways might be cleared, or even partially cleared. The greatest danger to travel during fogs is, of course, at crossings, where the dispersers would naturally be placed. For harbors much troubled with fog, such apparatus might also be useful on vessels. Sir Oliver Lodge succeeded in precipitating the fog throughout an area 150 feet in radius, so that two approaching vessels might have a clear view of each other when they were 300 feet apart, and, of course, an indistinct view at greater distances, depending upon the density of the fog. The ability to see 300 feet further would facilitate harbor traffic considerably, and probably often prevent collisions.

THE RADIOACTIVE SUBSTANCE IN THE WORLD.

In a recent contribution to the *Philosophical Magazine*, Mr. A. S. Eve makes some rather startling suggestions. He has speculated as to the possible amount of radioactive substances in the earth. Starting with a simple experiment to determine the ionization of the air, data are obtained which are used as a foundation for his argument. From his experiment he computes that if the ionization of the air has an average value equal to that which he found that this corresponds to an activity which would be produced by one-half gramme of radium per cubic kilometre of the atmosphere. Upon the further assumption that this ionization value is an average for the world, it is computed that to produce this activity of the layer of air surrounding the earth, one kilometre thick, would require at least 600 tons of radium bromide. Next, following the suggestion that the increase in temperature of earth as the centre is approached is due to radium, and assuming that the salts of this element are uniformly distributed, this 600 tons of radium would be contained in a layer of the earth only a few metres thick. The result thus reached indicates the possibility of radioactive substances being much more abundant than heretofore supposed, and suggests the further possibility that radioactive phenomena may play an important part in the life of the organic world.

ELECTRIC COOKING.

Electric stoves are winning for themselves a well-deserved position. Their advantages are many, and the cost of the apparatus and of operating it is not great compared with the comfort secured.

It is generally believed that cooking operations which can be performed on electric stoves are limited to boiling and baking. However, an oven fitted with incandescent heaters serves excellently for roasting, and there is no reason why the same principle should not be adopted for broiling and other culinary operations.

IS THE RAILWAY SYSTEM SELECTED BY THE NEW HAVEN ROAD ADAPTED TO THE NEW YORK CENTRAL'S TERMINUS?

In the ELECTRICAL REVIEW for October 7 attention was called to the decision of the New York, New Haven & Hartford Railroad Company to adopt the single-phase, alternating-current system. This followed the announcement by that company of the placing of an order for twenty-five single-phase, alternating-current locomotives. Since then further information has been received, which throws considerable light upon the situation thus brought about, and the question is now raised whether the system adopted by the New Haven road is suitable for operating over the electrical system of the New York Central & Hudson River Railroad, as it has been planned.

About three years ago, due to a serious accident in its tunnel, the New York Central decided to start immediately upon electrifying this section of its road—a plan which had been under consideration for some time past. This decision was followed by the appointing of a commission, consisting not only of operating engineers of the New York Central, but of outside experts, which commission has been engaged since its appointment in deciding upon the system to be adopted and in working out plans for putting it into service.

One of the first points to come up for decision was whether alternating currents or direct currents should be employed. At that time the direct-current system was the only one employed in this country, and it was known that it could be applied successfully to do the work in hand. The polyphase alternating-current system, as used abroad, was not thought suitable for the conditions existing at New York, and the manufacturing companies of this country were not ready to install a single-phase alternating system. Hence the decision was, under the conditions existing, necessarily made in favor of the direct-current system; and it must be said that the members of the commission are still fully convinced of the wisdom of their choice.

In addition to the development of suitable terminal facilities in New York, the commission, cooperating with the General Electric Company, has made many tests, and has decided upon a type of locomotive for hauling through traffic. It was decided also to adopt the multiple-unit motor-car system for the suburban traffic. It will thus be seen that a great deal of labor has been expended by the commission, and much has already been accomplished, so that changing over from steam to electricity on such an important road there may be no possibility of a hitch.

The two systems of operation by means of motor cars and locomotives for the suburban and the through traffic, respectively, having been decided upon, the terminal tracks have been planned so as to facilitate train handling. The terminal will be a two-story affair, the lower story devoted to the through trains, which, since they are hauled by locomotives, must be switched back and forth. The upper series of tracks will be given over to the suburban traffic, in which there need be no switching. Trains will enter on one series of tracks to let off passengers, and then move around a curve of short radius to a second series of tracks, to take on passengers. Obviously, in a system where the train movements are so frequent, it is of vital importance that no one set of trains should interfere with another set, either because of a different method of handling required at the terminus, or because of an inability to accelerate or run at approximately the same speeds as the other. The electrical commission of the New York Central believes that the system which the New Haven road proposes using will not fit in with the system which the New York Central is now installing. This opinion is not based on any criticism of the alternating-current system as a system, nor is it asserted that the work of the New Haven road can not be done satisfactorily in the way proposed; but it is firmly believed by the commission that the two systems, as they are now proposed, will not work together satisfactorily, and hence some change must be made.

The method of operating the New York Central trains has been outlined above. Now it is believed that suburban trains hauled by locomotives can not be handled on the upper series of tracks at the terminals, for there will be no provision there for trains hauled by locomotives. The curve connecting the incoming and outgoing trains is of very short radius—only about 135 feet—around which a ten-car train can not be hauled by a locomotive, although a train consisting of motor cars and trailers can round it easily. Then, again, the question of acceleration becomes important, not only on the suburban, but on the through tracks. While the single-phase, alternating-current apparatus can be operated on a direct-current system, to do so complicates it somewhat; and, moreover, since the single-phase motors are constructed for 250 volts, there is not the same facility for series multiple operation as there is with an equipment consisting of 500-volt motors. Hence it is also held that a New Haven train, in starting, will throw a considerably heavier load on the system than will a direct-current train, which, of course, would be objectionable.

Other questions have come up which, while of less importance, still must be decided soon. The New Haven road wishes to supply power to the section of the New York Central over which its trains run, as well as to its own lines beyond, and there is some doubt about the advisability of doing this, for it will make necessary a duplicate set of substations and call for the operation in parallel of two power stations under separate management.

The situation thus existing is serious, but it will doubtless be solved satisfactorily. It is due to the New York Central road to say that, recognizing the importance of its plans to the New Haven road, when its electrical commission first began its sittings, the latter road was invited to send representatives to these meetings. There has been no intention of going ahead and adopting what seems best to it without considering the effect upon the New Haven road. No criticism of the single-phase, alternating-current system is made, nor is there any made of the decision to adopt locomotives. The point at variance is

simply this: the New York Central's electrical commission believes that the system adopted by the New Haven road will not work in with the system the former is now installing as well as it should.

It may not be outside of the subject to say a word about the electrification of railways in general. It should not be forgotten—although it frequently seems to be—that the electrification of the New York Central's terminus and suburban lines was not undertaken to effect an economy in operation. The change was forced upon the company by certain peculiar conditions, and it is dangerous to use this as a precedent for the electrification of trunk lines in general. There is also an unfortunate tendency to hail electrification as the cure-all for railway troubles. We have seen, not long since, arguments attributing certain satisfactory results on important city lines to its electrification, when, as a matter of fact, the electrification was only one part of the cure. It was claimed that the great increase in carrying capacity of a certain road was due entirely to the electrical system, while the truth is, much of the increase was secured by the adoption of longer trains. Although with the old motive power the longer trains could not have been handled satisfactorily, there is no reason to believe that had the electric system not been available, some other solution, satisfactory for a time, at least, would have been found. The electrical system has a number of advantages peculiarly its own, and, at the same time, it has certain disadvantages, such, for example, as the cost of installation of the system. These are, of course, properly recognized by engineers, and they enter into every problem. But to proclaim loudly that electricity should have the credit for everything that has been accomplished is apt to do more harm than good. The electric railway system has no need of such praise. It stands to-day upon its past record, and it asks for consideration upon its merits; it needs no shouting to help along its cause.

ELECTRICITY ON SHIPBOARD.

The electric motor, applied with such excellent results for driving auxiliary apparatus on shipboard, has now gone a step farther. The steamship Amerika, the latest addition to the Hamburg-American Line, has made the fullest use of electrical appliances. Besides the numberless small motors driving machinery throughout the ship, she has an electric elevator communicating with the different decks, electric call systems, and a telephone exchange. The safety of the vessel has been provided for by electrically operated bulkhead doors, which can be controlled from the bridge, and a submarine signaling system. The comfort of the passengers is cared for by electric light, electric fans and even electric baths. In fact, it would be hard to find an instance in which more, and more varied, uses of electricity have been made than that of this magnificent vessel.

The Amerika is, of course, provided with wireless telegraph apparatus, which reminds us that this system of communication was used to excellent purpose three times in one week recently. A ship in a sinking condition called for assistance, and got it, by means of wireless. A second vessel, approaching this coast, was warned of a dangerous derelict drifting about in her course; and a third vessel, reaching the outer harbor of New York during a thick fog, in a casual way sent in word that she would not attempt to pass the Narrows until the next morning. Such instances are becoming so common that they cause little comment, but they are nevertheless wonderful.

MOTOR LOCATION.

The motor drive having become practically the standard for a great many kinds of work, it is well that attention should be called to certain phases of this use. Since the motor is generally small, as compared with the machine which it drives, and since the gain secured by abolishing countershafts and belts has been so greatly appreciated, there is a disposition to go to the other extreme and to tuck the motor into some corner where it will not only be out of the way, but inaccessible. One, at times, finds motors placed under machinery, so that it is next to impossible to get at the commutator or brushes, and difficult, indeed, to inspect the bearings. It must not be forgotten that, although the motor of to-day is a sturdy machine, it is more complex than a fast-and-loose pulley transmission, and therefore requires more attention and more consideration. The machinist of a few years ago was accustomed to throw on power by a movement of the hand. When the electric motor was first introduced to machine driving, it was found that the machinist was apt to follow his own methods and throw the controller handle all the way around with one movement. Moreover, since the care given the overhead line-shaft by the machinist was little or none at all, he was apt to drift along in the same old way and give little or no attention to his motor. This practice will be partially overcome, at least, if the motor be placed in an accessible position and in full view—and the foreman insist upon it that it be cared for properly.

The practice of throwing on the full power at once has been overcome by the introduction of automatic motor-starters, which prevent abuse of the machine. However, this does not provide for the sudden load on the motor due to blocking of the work or any sudden change in the load. With the old belt drive some flexibility was possible, but with a directly geared motor there is no cushion for the shock. Motors to-day are, however, so sturdy and so well designed that they can stand hard work of this kind without being destroyed; but this is only another reason why they should receive proper care. True, in some applications of the motor, the conditions could hardly be worse. For example, the motors on an electric car are exposed to all conditions of weather; they catch all mud and water thrown up from the street, and are almost inaccessible. This, however, can not be helped, since it is necessary that they should be placed where they are. But the railway manager recognizes the severe conditions under which his machinery is operating, and provides pits at the carsheds, where the motors are thoroughly and regularly inspected. So in the shop or factory, the motors should be arranged so as to be easily inspected and cleaned.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY.

BY HARRY C. JONES.

CHAPTER VII.

Other Radioactive Substances in Pitchblende.

There are apparently other radioactive substances in pitchblende, in addition to radium. There seems to be a new radioactive substance in this mineral that is closely allied to bismuth. It has already been referred to under the name of *polonium*. It is precipitated along with the bismuth, from the hydrochloric acid solution of the pitchblende residue, by means of hydrogen sulphide. It has thus far been impossible to free the supposed polonium from bismuth. Partial separation has apparently been effected, or at least a strongly radioactive substance has been obtained by precipitating the nitric acid solution by water. The subnitrate that is thrown down is much more radioactive than the unprecipitated portion.

It seems yet to be a question whether this radioactive bismuth really contains a new radioactive element, or is simply bismuth made radioactive by the deposition upon it of a substance coming, as we shall learn, from the radium in the pitchblende. If there is a new radioactive element associated with the bismuth, it might reasonably be expected to show definite and characteristic lines in the spectrum, as radium does. Demarçay, who worked out the spectrum of radium, was unable to find any new lines produced by the radioactive bismuth. Sir William Crookes, on the other hand, announces a new line for this substance in the ultraviolet.

If, however, it should be shown that the radioactive bismuth contains no new line, it does not prove, as Mme. Curie points out, that there is no new element contained in this substance, since there are many elements known that do not have any well-characterized spectrum. An experiment performed by Marckwald in 1902, may throw some light on the nature of polonium. If a stick of bismuth is plunged into the solution of active bismuth chloride obtained from pitchblende, it becomes covered with a black deposit which is extremely radioactive, and the remaining solution is no longer radioactive. This deposit is mainly tellurium, with a very small amount of the radioactive substances. An active deposit is obtained if tin chloride is added to the radioactive bismuth chloride. Marckwald thinks that this radioactive element is analogous to tellurium, and calls it *radiotellurium*. It has properties strikingly analogous to the polonium of the Curies, the analogy being especially marked between the kinds of radiations sent out by it. More work is required to show whether these substances are identical, or are different.

It should, however, be stated that the fact that polonium is precipitated from a solution of radioactive bismuth by simply introducing a piece of bismuth, would alone indicate that these substances are fundamentally different. It is well known that no metal can precipitate more of the same metal from a solution of any of its salts. In order that a metal may be able to precipitate another from its salts, it is necessary that the metal which is thrown out of solution should have a much lower solution-tension, or stand lower in the tension series than the metal which throws it out and takes its place. The metal which passes into solution must have the power to take the charge from the ion of the metal that is thrown out, becoming itself an ion, while the original ion is converted into an atom.

It has already been mentioned that Debierne obtained from pitchblende an active substance, which he termed *actinium*. This substance is quite different from radium, and also from polonium. It comes out of pitchblende along with the rare earths, and especially with thorium, to which it is very closely allied. This is probably the same substance as that obtained from pitchblende by Gietel along with other rare elements of the cerium group. The occurrence of actinium with thorium has raised the question whether the apparent activity of thorium itself is not really due to the admixture of a small amount of actinium. Certain properties of the radiations given out by the two substances are, however, sufficiently different to indicate that they do not have a common origin. This question can be settled, as Rutherford points out, if thorium can be obtained that is free from activity. Since, however, it is doubtful whether this has been done, it would be premature to conclude that all the radioactivity of thorium was due to the presence of small amounts of actinium. No spectrum has as yet been observed for actinium. Other radioactive substances have been announced as coming from pitchblende. Thus, Elster and Gietel in 1899 thought they had obtained radioactive lead. It is probable that these substances either contain small amounts of the other radioactive substances, known to exist in pitchblende, such as radium, and probably polonium and actinium, or are made radioactive by the presence of other radioactive substances. We shall learn that certain radioactive substances have the property of making other substances in contact with them radioactive.

This kind of radioactivity is known as *induced radioactivity*. We shall become more familiar with this subject when we come to study more closely, in a subsequent chapter, the nature of the radiations given off by radioactive substances.

We have now taken a brief survey of the steps involved in the discovery and isolation of the radioactive elements, and especially of the best known of them all —radium. The next step in order of logical sequence is to study the properties of these various substances, starting, perhaps, with the less active, uranium and thorium, and then taking up the more active, especially radium, about which so much, and such important knowledge has already been gained.

The methods that have been employed in these investigations are not obvious, and, therefore, should be briefly considered before the results that have been obtained through their application.

The More Important Methods Used in Studying Radioactivity.

The methods that have been employed in studying radioactivity are based, of course, upon the properties of the radiations that are given out by the various radioactive substances.

We have seen that such substances affect a photographic plate exposed to their radiations. It will be remembered that it was by means of this property that Becquerel discovered the first radioactive substance—uranium. Although this method is still used for certain purposes, there are a number of objections to its general use in connection with the study of radioactivity. In the first place, it is not sufficiently sensitive for work with weakly radioactive substances, such as uranium and thorium—it requiring too long exposure to produce in such cases the necessary impression upon the plate.

Another serious objection to the photographic method is that certain radiations given off from radioactive substances, even when fairly intense, have very slight action upon the photographic plate. The photographic record would thus be only a very partial one, of the total radiations given off by radioactive substances. Another objection to the photographic method is a somewhat general one. Photographic plates are sensitive to such a number of agents. If anything is brought *in*

contact with a photographic plate, an imprint is left on the plate when it is developed. This can, however, be overcome by suitable precautions, and photography has proved of invaluable service in the development of scientific knowledge.

Taking all of these facts into account the photographic method is not well adapted to the study of radioactivity in general, although it has certain special applications which are important, as we shall learn.

Another property of radioactive substances is to cause certain substances upon which their radiations fall, to fluoresce. This is especially true if the radiations are allowed to fall upon screens covered with the beautiful salt barium platinocyanide. This *fluoroscopic* method is of very limited applicability, since weakly radioactive substances do not produce enough fluorescence in these screens to be observed. This method could be used only with such substances as radium, polonium, or actinium and could not be employed at all with such weakly radioactive elements as uranium and thorium.

We have already seen that the radiations from radioactive substances have the power to discharge charged bodies surrounded by a gas such as the atmosphere. This means that such radiations have the power to render a gas like the air a conductor of electricity. In a word, to ionize the gas into the negative electron and the relatively large positive ion.

A method based upon this property of the radiations has proved of the greatest service in connection with the study of radioactivity. Indeed, it is the only method that is capable of giving reliable quantitative measurements.

In determining the amount of ionization produced in the gas it is necessary, as Rutherford points out, to use an electric field strong enough to produce what is known as the saturation current through the gas. This means an electric field strong enough to prevent any appreciable number of the ions formed in the gas by the radiations from recombining. The velocities with which the ions move toward the positive and negative poles, respectively, of the source of the current, is proportional to the strength of the field. When the current has reached a certain voltage the ions are rushed across toward the poles so rapidly that no appreciable number combine. The current attains a maximum value under these conditions, which does not increase even when the voltage is largely increased. This is known as the maximum, or saturation current.

The value of the voltage necessary to produce this current varies with the radioactivity of the substance under examination. The more intense the radioactivity, the more rapidly the ions are produced in the gas, and, consequently, the greater the voltage required to produce the saturation current.

Rutherford states that for substances whose radioactivity does not exceed 500 times that of metallic uranium, a field of 100 volts per centimetre is sufficient to produce the saturation current, while the electromotive force required to produce the saturation current is so great when comparatively pure specimens of radium are under investigation, that the gas through which the radiations and the current pass is placed under diminished pressure.

For details in connection with the measurements of the conductivities of gases through which the radiations from radioactive substances are passing, the original investigations, especially of Rutherford, must be consulted.

THE NATURE OF THE RADIATIONS GIVEN OUT BY RADIOACTIVE SUBSTANCES.

We have already become familiar with the fact that radioactive substances give out radiations that have the property of affecting a photographic plate, of rendering certain substances fluorescent, and of ionizing gases.

The question would naturally be raised, are the radiations given out by all radioactive substances the same in character? Again, are all the radiations given out by any one radioactive substance of the same nature?

These questions are easily asked, but can be answered only by experimental work, and this not always of a very simple kind. It is, however, not a difficult matter to show qualitatively that the radiations given out by a radioactive substance, such as radium, are not homogeneous, but are *complex* in character.

If we charge a gold-leaf electroscope and subject it to the radiation from radium, it will be rapidly discharged, due to the ionization of the air produced by these radiations. If now we interpose between the radium salt and the electroscope a thin sheet of metal, or even a piece of paper, the electroscope will be discharged much more slowly, showing that a portion of the radiation has been cut off. If we then interpose into the path of the rays a thick piece of metal, the electroscope will be discharged much more slowly than when a piece of metal foil was used. The interposition of a second such piece of metal has but little effect.

These qualitative experiments show conclusively that the radiation from radium is heterogeneous, consisting of different kinds of rays. The most natural interpretation of these results would be that the piece of thin sheet metal, or metal foil, cuts off a kind of radiation that has relatively little power to penetrate matter, and that the thick piece of metal cuts out a more penetrating kind of radiation, leaving a third, highly penetrating form pass through, which of itself was capable of ionizing the gas to a slight extent and slowly discharging the electroscope.

While this is, perhaps, the most obvious interpretation of the results of the above described, very crude experiment, it remains to be seen whether it is the correct interpretation.

It was observed by Elster and Gietel that the ionization, and consequent conductivity of air, produced by the radiations from radium, was changed when the radiations were subjected to a magnetic field. This suggested to Gietel the desirability of studying the effect of the magnetic field on the radiations from radium in general. Results of the very highest importance were obtained. He found in 1899 that at least some of the radiations from radium could be deflected by the magnetic field, which accounted for the change in the conductivity produced in the air by the radiations, when these were made to pass through a magnetic field.

A little later (1900) M. Curie showed that the radiations from radium consisted of two kinds, one that was not deflected or deviated in the magnetic field, and another that was deviated by the field. The kind that was not deviated had very little penetrating power, and was the kind that is so readily stopped even by a thin sheet of metal foil.

The kind that was deviated by the magnetic field had much greater penetrating power, and was capable of passing through thin sheets of metal. It could not, however, pass through sheets of metal of any appreciable thickness.

About the same time (1900) it was shown by Villard that the radiations from radium contain a third kind of rays, that have very great penetrating power, and are not deviable by the magnetic field. The radiations from radium contain, then, three kinds of rays, each with

its own definite, characteristic properties. These have been named the

Alpha (α) rays.
Beta (β) rays.
Gamma (γ) rays.

We can now understand the qualitative experiment at the beginning of this chapter.

The thin sheet of metal cut off the α radiations, but allowed most of the β, and practically all of the γ radiations to pass through. When the α rays were cut off the air was ionized much less rapidly, for, as we shall learn, the α rays are the chief ionizing agents in the radium radiations, and the electroscope was discharged much less rapidly than when they were allowed to pass through the air between the leaves of the electroscope.

The thick piece of metal cut off the β radiations and allowed only the γ radiations to pass. The electroscope was now discharged much more slowly, since the γ radiations have less power to ionize a gas than even the β radiations, which in turn have much less ionizing power than the α radiations.

Our original conclusion from the facts of the qualitative experiment is then correct. The radiations from radium consist of three distinct kinds of rays.

We shall now proceed to study the properties of these in some detail, taking them up in the order, alpha, beta and gamma, and not in the order of their discovery.

It may be said in advance that all three radioactive substances—uranium, thorium and radium—give out these three types of radiations. Polonium, as we shall learn, gives out only one type—the α radiations.

HOW TO USE THE SLIDE RULE ON THE WIRE TABLE.[1]

BY Y. SAKAI.

Hold the slide rule upside down with the back scales S, L and T of the sliding part in view at the right-hand end.

On the L scale find the number representing the size of the wire whose resistance is desired.

Place this number opposite the index on the other part of the rule.

Turn the rule right side up and the reading on the lower scale of the stationary part opposite the end of the scale on the sliding part is the required resistance.

Example—Find the resistance of 1,000 feet of No. 5 B. & S. copper wire.

Place the point 5 of the L scale opposite the index.

Turn the rule over and read the D scale opposite the left-hand end of the sliding scale C. See Fig. 2. The integer result is 3,162.

The decimal point can be fixed by remembering that the resistance of No. 10 wire is one ohm per thousand feet and that the resistance of No. 0 is 0.1 of an ohm. Obviously the resistance of No. 5 is 0.3162 ohm.

To find the resistance of wires larger than No. 0 and smaller than No. 10, it is only necessary to remember the rule given by Mr. Scott.[1]

"A wire which is ten sizes larger than another wire has ten times the weight and one-tenth the resistance."

Obviously a wire twenty times larger has one hundred times the weight and one-hundredth of the resistance. For example, to find the resistance of No. 17 wire, find the resistance of No. 7 and multiply it by ten.

Explanation—The formula, $R = 0.1 \times 2^{\frac{n}{3}}$ ohms, given by Mr. Pender[2] may be written:

$$\text{Log } R + 1 = \frac{n}{3} \times 0.30103, \text{ or}$$

$$\text{Log } (10\ R) = \frac{n}{10}, \text{ approximately.}$$

That is,

One-tenth of the size number of B. & S. copper wire is approximately the logarithm of ten times the resistance of 1,000 feet of that wire.

The L scale on the slide rule represents the decimal portion of the logarithms of the numbers on the D scale.

The results derived from the slide rule are for a temperature of about seventy-five degrees Fahrenheit and will check within one per cent with the values given in the standard tables for sizes between No. 0000 and No. 16. For the smaller sizes the results will be below, and for the larger sizes the results will be above those given in the tables. For No. 36 the resistance as calculated on the slide rule is about five per cent low.

[1] Reprinted from the *Electric Journal*, October.

[1] See the *Electric Club Journal*, vol. ii, p. 220.
[2] See the *Electric Club Journal*, vol. ii, p. 357

The Railway Signal Association.

The ninth annual meeting of the Railway Signal Association was held at Niagara Falls, N. Y., October 10, 11 and 12. President J. C. Mock called the convention to order and pointed out the vast responsibilities which rest upon the members of the association in the practical work of the signal engineer.

One of the first things which was inaugurated at the official session was the authorization of the publication of a volume of about 500 pages, containing the abridged proceedings of the association from its organization. Committee reports were presented and discussed.

On the last day of the session, October 12, the election of officers for the ensuing year resulted as follows: president, C. H. Morrison, Erie Railroad, Jersey City, N. J.; vice-president, J. A. Peabody, C. & N. W., Chicago, Ill.; secretary, H. S. Balliet, Grand Central Station, New York city; fourth member of the executive committee, J. C. Mock, electrical engineer, Detroit River Tunnel Company, Detroit, Mich. Washington, D. C., was selected as the place for the next annual meeting.

Proposed Consolidations.

The news in some sections of electrical circles and allied interests the last few weeks has been to the effect that a general consolidation is under way between the American Locomotive Company and the General Electric Company, and between the Bullock, Allis-Chalmers and General Electric companies. Despatches from Schenectady and Milwaukee to the press of this city have apparently confirmed this view. The election of Mr. Charles A. Coffin, president of the General Electric Company, to the board of directors of the American Locomotive Company was also pointed to as a confirmation of these reports.

There is evidently no doubt that the proposition of gradually equipping the steam roads of the country with electric locomotives has caused a closer business acquaintance between the General Electric and the American Locomotive companies, but it is denied that there has been any consolidation of the two companies.

In respect to the purchase of the Allis-Chalmers Company by the General Electric, no confirmation could be secured at the offices of either company in this city; in fact, the probabilities of such a consolidation, or the intimation that it had ever been representatively discussed, was authoritatively denied by officials of the two companies.

The New York Electrical Society.

The 253d meeting of the New York Electrical Society was held in the auditorium of the New York Edison Company, 44 West Twenty-seventh street, New York city, on Monday, October 23. Mr. Peter Cooper Hewitt gave a very interesting address upon "Electrical Reactions of Gases." Mr. Hewitt described in detail the various phenomena which have been discovered in the research connected with the conduction of electric current through a vapor path. The differences in the characteristics of purely metallic conduction and vapor path conduction were explained in simple language, and Mr. Hewitt's address was highly edifying and instructive.

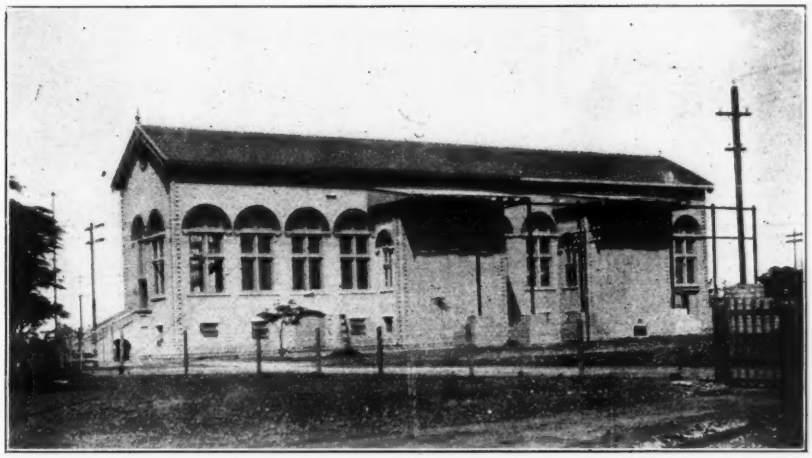
The Largest Hydroelectric Installation in Southern Asia—III.

Electricity for Industrial Purposes in India.

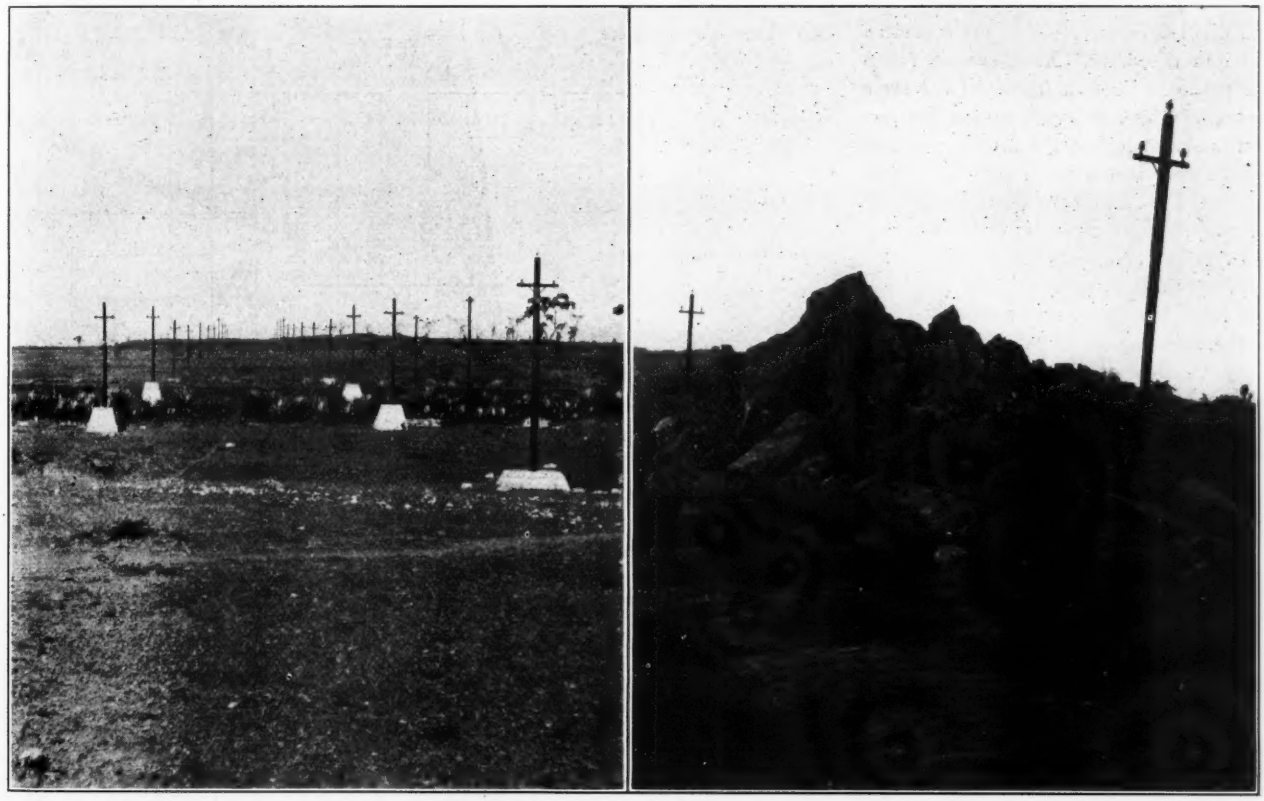
By A. C. Hobble.

TRANSMISSION LINES.

THE standard line construction makes use of composite poles consisting of a heavy seven-inch wrought-iron socket thirteen inches long with a seven by seven-inch Australian jarrah-wood top which is seventeen feet in length and is let into the iron socket a distance of twenty-one inches, thus making a pole twenty-eight and one-quarter feet long. The poles are set six feet into the ground and are spaced about 130 feet apart. The two Kolar transmission lines, consisting of 1/0 B. & S. copper wire arranged equilaterally with forty inches between wires, run parallel sixty feet apart and are supported on white porcelain insulators of Italian make having five petticoats. Iron pins are cemented into the insulators with Portland cement, and it has been observed that this is one of the causes of an occasional cracked insulator.



STEP-DOWN TRANSFORMER STATION SHOWING THE TWO TRANSMISSION LINE ENTRANCE TOWERS—KOLAR GOLD FIELD.



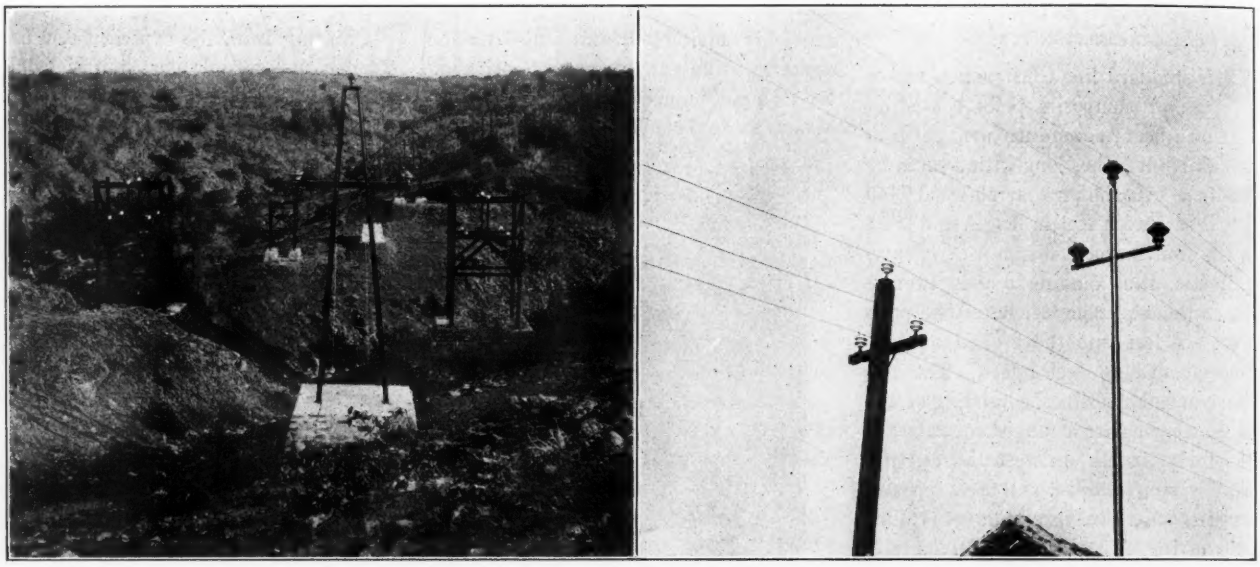
TRANSMISSION LINES CROSSING LEVEL AGRICULTURAL COUNTRY, AND A BIT OF THE ROUGH COUNTRY—BETWEEN SIVASAMUDRAM AND THE KOLAR GOLD FIELD.

Several poles have been rendered unserviceable by lightning strokes. This climate is very severe on wood exposed to the sun—causing "dry rot"—it being undoubtedly advisable (taking also the destructive white ant into consideration) to use iron poles and cross-arms. The slight advantage to be obtained by the use of wooden poles is more than offset by the trouble and cost of necessary renewals and their short life as compared with iron poles.

Profiting from the experience of using wooden poles and porcelain insulators with cemented iron pins on the two Kolar transmission lines, it was decided to use wrought-iron poles with iron cross-arms, and high-tension insulators with wooden-headed pins in the construction of the Bangalore-Sivasamudram transmission

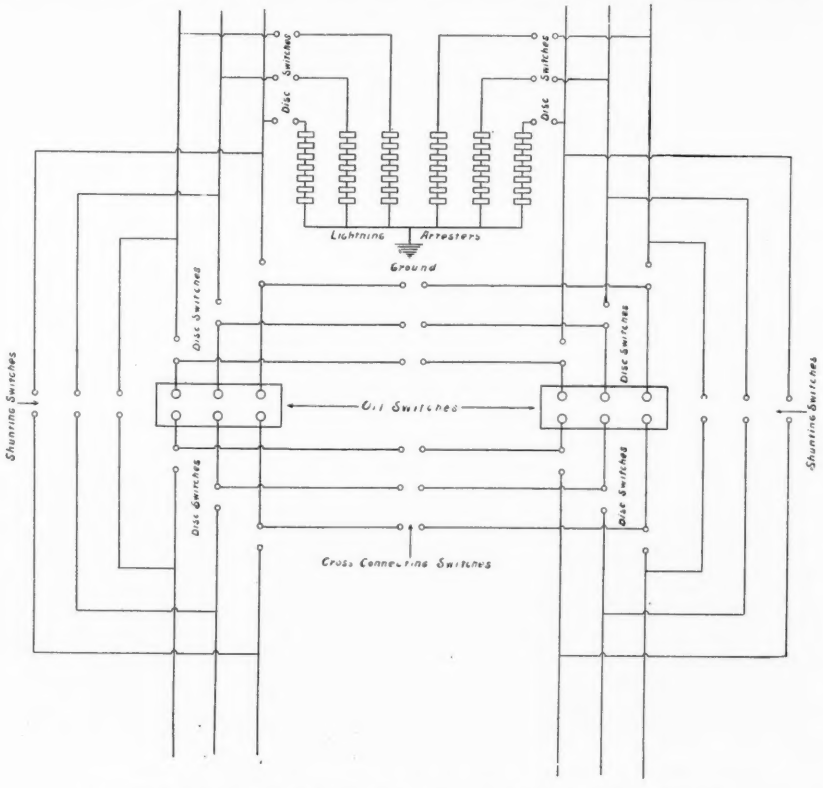
line. This line is sixty-two miles long and is composed of No. 5 B. & S. copper wires supported equilaterally forty inches apart on Locke brown porcelain insulators. The latter are eleven inches high and divided into three sections cemented one into the other. Each section forms one petticoat. The diameter of the large umbrella-shaped petticoat of the top section is eleven inches, the middle petticoat is six inches in diameter, and the bottom petticoat five and one-half inches. An accompanying photograph illustrates the two types of insulators mounted on poles, the larger one being the Locke insulator. The latter has been tested at 100,000 volts at the factory. Thus provision has been made, by the use of these high-voltage insulators, for a future increase of the line pressure should occasion require.

The Bangalore line runs parallel with the two Kolar lines and at one-third of the distance between them as far as Kankanhalli station. This spacing leaves ample room for a fourth transmission line. The poles are cylindrical, hollow, with one-fourth-inch thickness of metal and are divided into three lap-welded sections measuring six feet, eight feet and fourteen feet in length of top, middle and bottom sections respectively and with outside diameters of three inches, three and one-half inches, and four inches. The total length of the pole is twenty-eight feet. The cross-arm is a two and one-half by two and one-half-inch angle-iron about forty-four inches long. The insulators supporting the two lower wires are bolted to this angle-iron. The top insulator is bolted securely to a small angle-iron, which in turn is bolted inside of the top of the iron pole.



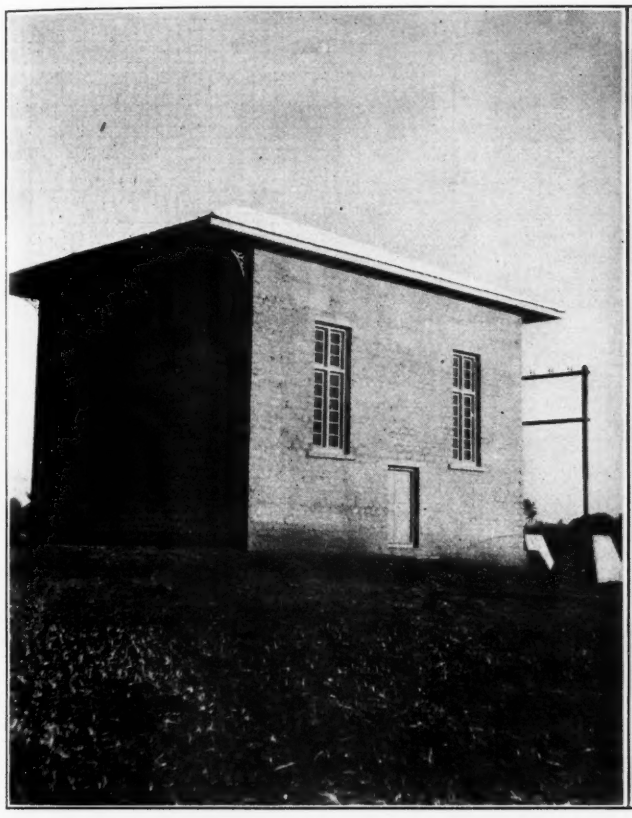
TRANSMISSION LINES NEAR SIVASAMUDRAM; IRON STRUCTURE IN FOREGROUND SUPPORTS BANGALORE TRANSMISSION LINE ON LOCKE INSULATORS. VIEW OF POLE TOPS AND INSULATORS; BANGALORE TRANSMISSION LINE, WITH LOCKE INSULATORS, ON THE RIGHT; KOLAR TRANSMISSION LINE ON THE LEFT.

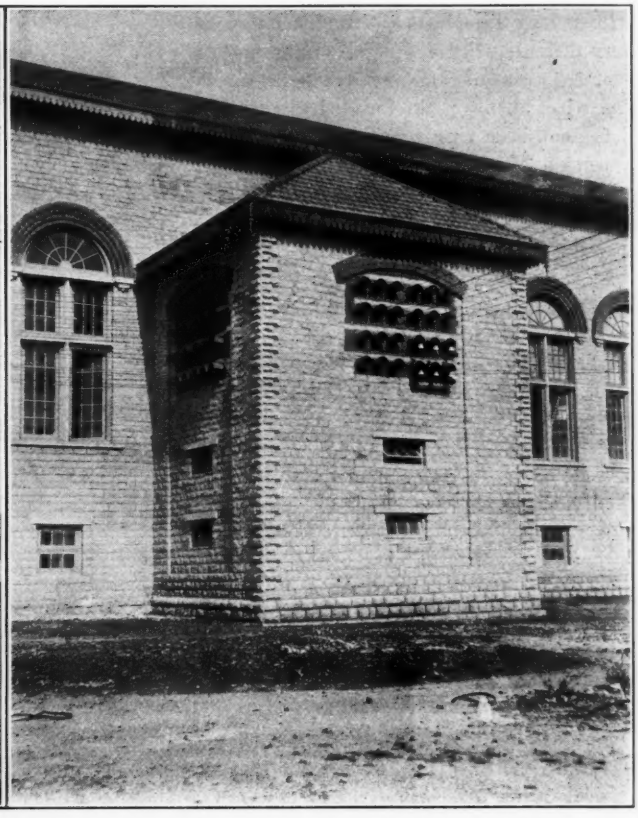
Two section houses are located at such points on the Kolar lines as to divide them into three approximately equal sections. Each section house contains the necessary switching apparatus for either isolating or paralleling the sections of transmission line under its control. This is a most advantageous arrangement as only one-third of one line need be out of service at any one time for repairs, leaving five-sixths of the original copper in service. Herewith is shown the general arrangement of switching apparatus in the section houses; one of which is located at Kankanhalli and the other at Sarjapur. An at-



GENERAL SCHEME OF WIRING IN TRANSMISSION LINE SECTION HOUSES.

tendant is always stationed at each section house in case he may be needed at any time for "cutting-out" a section of line.

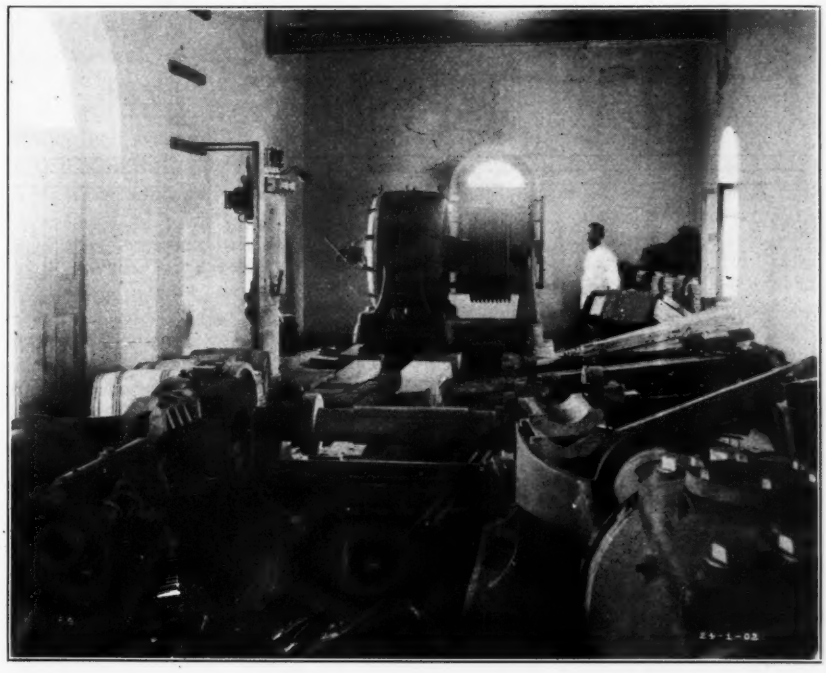




TRANSMISSION LINE SECTION HOUSE AT KANKANHALLI. NEAR VIEW OF LOW-TENSION DISTRIBUTION TOWER, TRANSFORMER STATION, KOLAR GOLD FIELD.

Another desirable feature is the increased protection of the transmission lines through the installation of lightning arresters in the two section houses. All of the arresters are of the high resistance carbon air-gap type manufactured by the General Electric Company, Schenectady, N. Y. Observance of the effects of lightning discharges on different parts of the transmission lines reveals the fact that those sections at river crossings, although they are the lowest points, generally sustain the most damage. This would tend to prove that the proximity of moisture plays a most important part. Of the several river crossings the longest span is 580 feet. Silicon-bronze cables are used at these points. They are spread out horizontally about ten feet apart and anchored on special reenforced pole structures.

The lines cross a country of varied topographical features, including hills, rivers, level agricultural country and country overgrown with jungle. In the ninety-two miles of line between Sivasamudram and Kolar the line wires undergo three complete transpositions. Supported on the poles of one of the duplicate transmission lines, on cross-arms located six feet below those carrying the main wires, is the telephone line establishing communication between Sivasamudram and Kolar and intermediate points on the line. A small telephone exchange is located in the section house at Kankanhalli, at which place the line superintendent is stationed. A branch



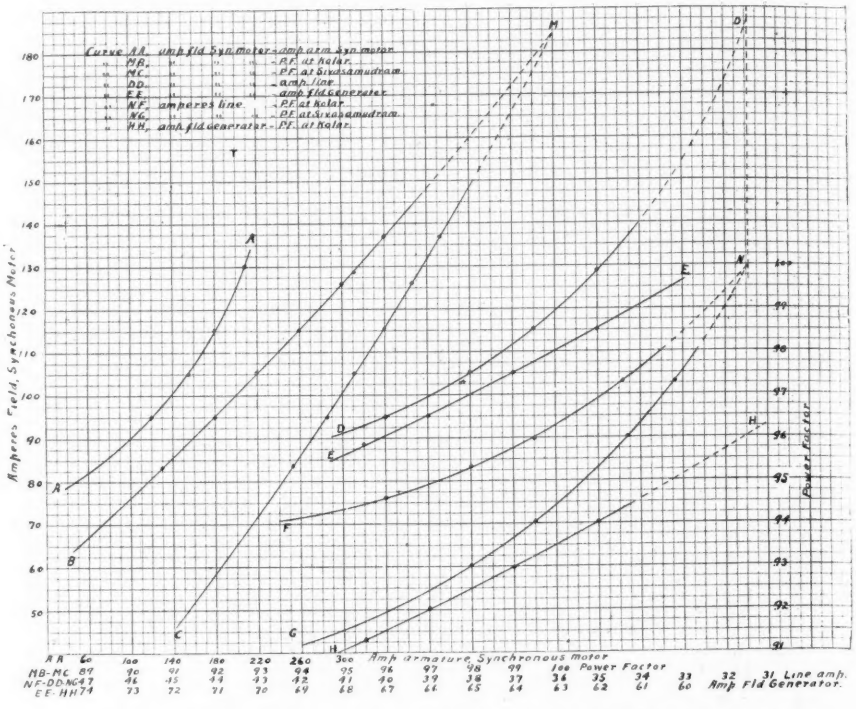
ASSEMBLY OF INDUCTION MOTOR DRIVEN INGERSOLL-SERGEANT AIR-COMPRESSORS AT COROMANDEL MINE—KOLAR GOLD FIELD.

line from the latter place communicates with the head office at Bangalore. The telephone wires are transposed every fourth pole. Telephone communication is very difficult when a ground occurs on one of the transmission lines. The telephone wires then get an induced charge and the call-bells ring continuously until the source of disturbance is removed. During the dry season the line wires become heavily charged with atmospheric electricity and this also affects the telephone line to some extent. On the whole, however, telephone communication is very satisfactory.

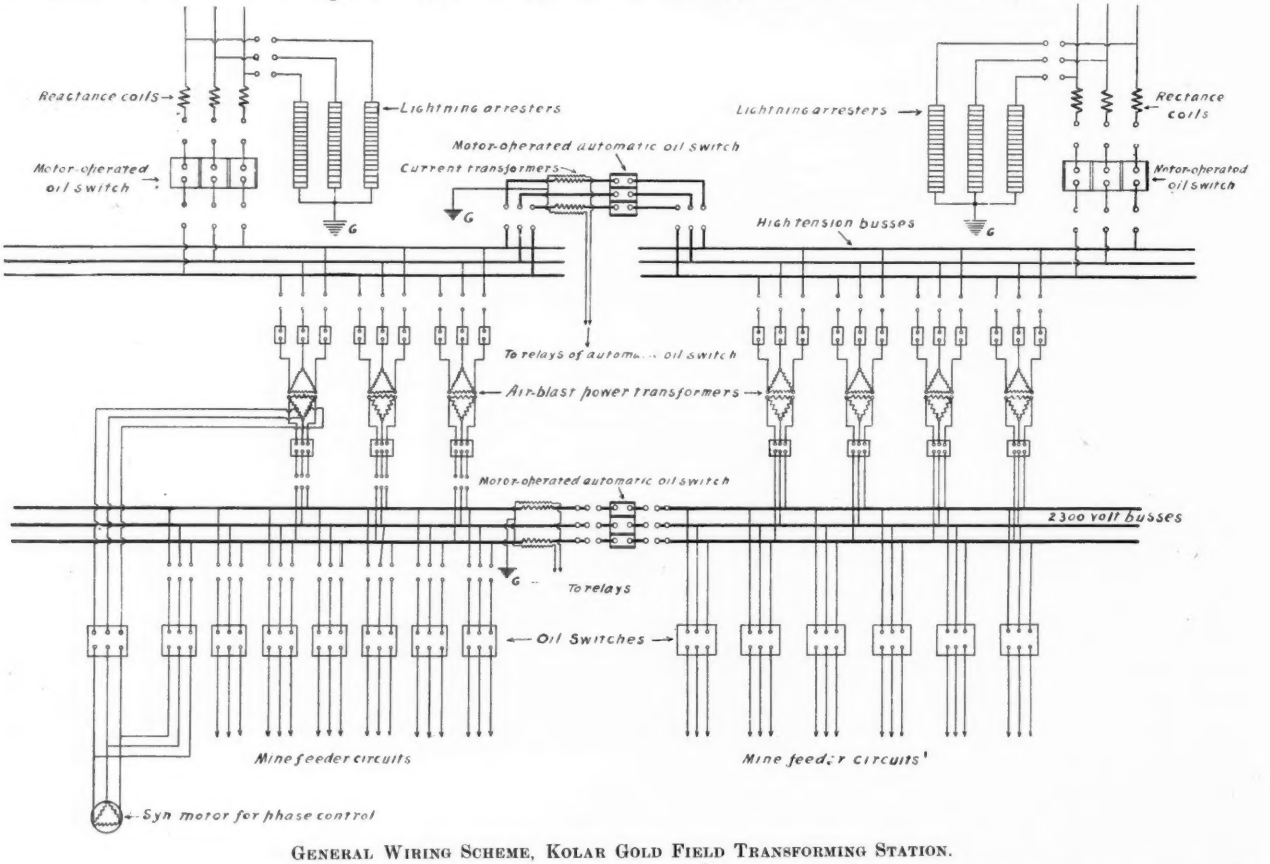
Much trouble and annoyance has been caused by natives cutting the telephone wires and making use of the copper obtained thereby for making jewelry and fancy articles. In order to correct this difficulty, after having used all other means at disposal and failed thereby, it was found effective to charge the line during the night with a pressure of 1,000 volts. In case it is desired to reestablish communication during the night, a lamp and fuse is the signaling device.

KOLAR DISTRIBUTION.

The step-down transformer station at the Kolar gold field is, of course, the electrical centre of distribution of power to the various mines. Here the current is received at a pressure of approximately 30,500 volts and is stepped down to 2,300 volts for distribution. About 3,650 horse-power is used for driving air-compressors, 2,900 horse-power for the operation of stamping mills, while approximately 500 horse-power operates small hoists, pumps and stone-breakers. Motors rating from 100 horse-power up to 400 horse-power are wound for 2,080 volts and the smaller ones for 220 volts.


Curve AA, amp fld Syn. Motor - amp arm Syn motor
" MB, " " " - P.F. at Kolar
" MC, " " " - P.F. at Sirsamudram
" DD, " " " - amp. line
" EE, " " " - amp fld Generator
" NF, amperes line - P.F. at Kolar
" NG, " " - P.F. at Sirsamudram
" HH, amp fld Generator - P.F. at Kolar
Amperes Field, Synchronous Motor
Power Factor
Amp armature, Synchronous motor
Amp Fld Generator.

CHARACTERISTIC CURVES OF PHASE CONTROL OF TRANSMISSION LINES.



GENERAL WIRING SCHEME, KOLAR GOLD FIELD TRANSFORMING STATION.

During the first installation some thirty motors and eleven Ingersoll-Sergeant Drill

Company's air-compressors were installed by the General Electric Company. All of the air-compressors, with the exception of three, are driven by induction motors; two Ingersoll-Sergeant and one Walker compressor being driven by synchronous motors. All of them use rope drive. All of the synchronous motors and several of the larger induction motors use starting compensators. Resistance starting for induction motors is, however, much preferred where the starting of such motors is of frequent occurrence, as must necessarily be the case in mining installations.

Below is given a list of the several gold mines with the approximate of electric power consumed by each.

	Horse-Power.
Mysore	1,750
Champion reef	1,950
Oorgaum	1,175
Nundydroog	500
Oriental	150
Balaghat	450
Tank block	350
Coromandel	150
Gold field	150
Nine reefs	150

Though this is the motor rating, the actual rating, or horse-power consumed, will fall somewhat below these values.

Though the general arrangement in the Kolar transformer station is much the same in most respects as that at Sivasamudram, there are one or two additional features worthy of consideration. One of these is the installation of a 1,000-horse-power synchronous motor which is used solely for phase control or power-factor regulation of the system. With proper control of the field excitation of this motor, assisted by the field excitation of the three synchronous motors used for power purposes, it is possible to operate with normal load near unity power-factor.

Phase control of long transmission lines is now considered almost as important as voltage control. Low power-factor means greater line loss, over-excitation of generator fields, heavy overload armature current for full kilowatt output of generator, and, in fact, low efficiency of the whole system. Strengthening the field excitation of the synchronous motor decreases the line current and consequently the armature and field currents of the generators. The synchronous motor, instead of the generator, supplies the lagging or so-called "wattless" component of the current. In addition to controlling the power-factor, the synchronous motor may also be used for voltage control within limits. As the power-factor is raised in value, the inductive loss on the line decreases, the voltage drop is lessened and the receiver voltage is correspondingly increased.

Though the electric power consumed by the mines has been almost doubled and the voltage of transmission raised only 5,000, the line loss for normal load has only increased from twelve per cent to approximately sixteen per cent due to the high power-factor obtainable. A critical examination of line characteristic curves shown in the accompanying diagram demonstrates the importance of phase control of transmission lines. These curves were taken with constant voltage and almost constant load at the receiving station. Attention is called to the decreasing difference between the values of power-factor at the transmitting and at receiving ends of the line, as current and voltage are brought more nearly into phase.

Another noticeable feature is the decrease of generator field current with increase of synchronous motor field excitation. This is due, of course, to the fact that the synchronous motor absorbs the so-called "wattless" current in the generator armature, which otherwise opposes the generator field magnetization, thus calling for an increase of exciting current to offset the demagnetizing armature current.

Reference to the diagram here reproduced will show that provision has been made for starting the 1,000-horse-power synchronous motor by means of half voltage taps on the secondaries of two transformers of one bank of power transformers. Thus we have practically a two-transformer, three-wire arrangement for securing half voltage (1,150 volts) for starting while the secondary of the third power transformer acts as a balancing coil.

The high and low-tension bus-section oil-switches are opened by automatic relays with a 2,000-kilowatt unbalancing of load on either side of the station. These switches are motor-operated from a storage battery of fifty-four cells. The battery is charged from the 1,000-horse-power synchronous motor exciter unit connected on the same shaft.

The low-tension switchboards on the main floor consist of eight transformer bank panels, sixteen feeder panels, three total output meter panels, one line and bus-section switch-control panel, three local lighting and blower motor panels, and one synchronous motor panel. In addition to the volt, watt and current meters on the synchronous motor panel is a power-factor meter. With rheostatic control of the field excitation of the motor, the switchboard attendant has direct control of the power-factor of the system as well as voltage regulation at the receiving station within limits.

(To be concluded.)

Train-Warning Device.

A device for warning trains is the subject of the following report by Consular Clerk Murphy, of St. Catharines. The report follows:

"Much interest has recently been aroused in Germany by the success of all practical tests to which the Pfirmann-Wendorf apparatus for preventing railway accidents was subjected by the managers of the Frankfort-on-Main division of the Prussian state railways, experiments covering a period of several months, which proved uniformly satisfactory even under the most unfavorable conditions due to rain, snow, fog and darkness.

"These experiments were made on a specially prepared track, several miles in length, extending from Goldstein to Sachsenhausen. Each locomotive used was supplied with a small Pfirmann-Wendorf apparatus, which with its storage battery occupied a space only twenty centimetres in depth and breadth, respectively, and thirty centimetres in length. Communication between this apparatus and the two track rails was supplied by the metal parts of the locomotive through the axles and wheels, while an insulated contact device connected the apparatus with a carefully insulated auxiliary rail running midway between the track rails, the contact device being so arranged that it could easily be moved back and forth or sidewise. Positive and negative impulses could thus be sent in different directions, frequent changes being made from one rail to another.

"If there is an obstruction of any kind within a certain distance, an alarm is thus given, both visibly and audibly, by means of a red light and by the ringing of a bell. No matter how many locomotives there may be on the track, each gives its warnings. Engineers, signalmen and station masters can thereupon communicate together by telephone, the central auxiliary rail serving as the channel of communication. In each locomotive there is a telephone which is protected against the vibrations caused by the motion of the locomotive through being fastened on springs like a bicycle lamp. In like manner in cases of sudden danger track guards can transmit a warning to the engineers of approaching locomotives.

"If for any reason a storage battery becomes exhausted it can be replenished with electricity produced by the locomotive and even if this supply fails, the current from a semaphore or signal station can still transmit to the engineer explanations and instructions. If by mistake a semaphore falsely registers "free track," the endangered trains nevertheless supply each other with signals of warning. An alarm is also given automatically when a switch is falsely set or insecurely closed.

"The auxiliary line, consisting of ordinary T-iron, may be limited to important or dangerous portions of the track where the view is obstructed or to the vicinity of sidings, curves, bridges and tunnels. Old rails may be used for the central auxiliary line."

REPORT OF COMMITTEE NO. 13 ON RUBBER-COVERED WIRE.[1]

BY AZEL AMES, JR., CHAIRMAN.

Rubber-covered wire for railway signal installation is generally used either as aerial cable or as single conductor as cable for ground use. Under the latter heading may be grouped all wires running in trunking or other conduit upon or under the ground or in the usual forms of shelters for batteries, relays or other signal apparatus. While most rubber-covered signal wire carries a current of very low voltage, that used in electric interlocking plants or in the charging circuits of storage battery installations is subject to pressures of from 110 to 600 volts.

The destructive forces affecting signal wires are severe and comprise mechanical injury, heat, moisture and chemical action, frequently several or all of these forces are active at the same time. The most destructive force affecting the rubber insulation of an aerial cable is heat, and the same may justly be said of wires run in trunking above the ground. Wires buried below the ground are as a rule either continually wet or alternately wet and dry, and in many localities the ground where they are run is saturated with oil, brine or acid. Frost also by the heaving of the ground and distortion of the conduit that it produces is a potent factor in shortening the life of rubber-covered wire in signal work.

In selecting materials or apparatus for many purposes some liberty may not improperly be taken as regards quality, and the use of a cheap article, even though it be a poor one, may often be justified, but any such practice must be condemned with the utmost severity whenever the apparatus or materials in question are in the nature of safety appliances and are used for the protection of property and life.

All railroad signal systems are supposed to be so designed that the failure of any part will cause the display of a stop indication and so be on the side of safety. We think that it is most important to inculcate the principle that all signal failures are dangerous, in that they cause delays which frequently lead to reckless running in order to maintain schedules, and in that they tend to bring the signal systems into disrepute with engine men and others whose acts the signals control. Add to the above consideration the money loss occasioned by train delays, the high expense of repairs and the still more serious possibilities of false clear signal indications, and it is at once apparent that it is both wasteful and unsafe to use any signal apparatus or material that is less than the best that skill can make or money buy.

The signal engineer with a laudable ambition to do the work often finds that his purchasing agent has an equally laudable ambition to get the best prices. These are generally secured through competition which unless guided and restrained by proper specifications, for the materials purchased, result in obtaining an article whose only merit is its low first cost. These same conditions are met to an even greater degree on contract work, where, in the absence of rigid specifications, signal companies are often tempted to supply cheaper grades of material to enable them to underbid their competitors. Some companies, in fact, have brought undeserved discredit upon their apparatus or systems by the use of rubber-covered wire, the insulation of which, while of good quality, was so thin as to be quite unsuitable, especially upon 110-volt work.

Some manufacturers by the excellence and uniformity of their products acquire reputations which enable them to command prices which are considerably in excess of those that yield a reasonable profit, and in buying rubber-covered wires and cables for signal work a number of roads have purchased almost entirely from some one manufacturer. Until recently but few concerns made high-grade rubber-covered wire for signal work, and a great deal of wire has been used in signal installations which was totally unfit for the purpose. It would appear then that to guide its members in the selection of proper wire and cable for signal purposes; to place on an equal footing all manufacturers who care to enter this rapidly growing field, and to secure to the railroad companies the benefits of a wider and freer competition; this association should set forth in the form of specifications its recommendations in this matter.

Dr. Carl Otto Weber in the preface to his authoritative work "The Chemistry of India Rubber," states that its very name would seem to suggest that our present-day knowledge of it consisted chiefly in the fact that it may be used for erasing pencil marks. Your committee recognizes most fully that generally speaking there is no manufactured product in the purchase of which the buyer puts himself so thoroughly in the hands of the manufacturer as in the rubber-covered wires and cables. The manufacturers, too, can not deny that in the past they have shrouded the subject in as much mystery as possible, and while there is, of course, no disposition on our part to pry into trade secrets, it is most true that the purchaser of any article is entitled to know just exactly what he is paying for.

To obtain a proper insulated signal wire it is necessary, first, to know what you want, and second, how to get it. Fortunately for the railroads, the federal government and some of the telephone and telegraph companies have been users of high-grade rubber-covered wire, and from the results of their researches and experiences we can obtain practically all of the data that we need.

Your committee has made some investigations, and while it is perhaps not wise to present at this time definite specifications for adoption, the following suggestions are put forth to provoke discussion and to lead to such study of the question as will result in complete specifications being issued by the association at an early date. The matter of cables has not been touched upon, as it was thought best to secure from the members further data as to the kind of cables in use as regards number, size and arrangement of conductors, filling, forming, covering, etc. Rubber-covered wire will be considered under the following heads, the suggested requirements and tests being set forth, followed by some discussion of the reasons for presenting them:

1. The copper conductor—(*a*) suggested requirements, (*b*) physical tests, (*c*) conductivity tests, (*d*) tests of tinning.

2. The rubber insulation—(*e*) suggested requirements, (*f*) physical tests, (*g*) chemical tests, (*h*) electrical tests.

3. Taping and braiding—(*i*) suggested requirements, (*j*) absorption tests.

4. Packing and shipping.

(*a*) Conductors must be soft-drawn, annealed copper wire, having a conductivity of not less than ninety-eight per cent of that of pure copper. Each wire forming a conductor must be continuous, without splice, throughout its length, must be uniform in cross-sections, free from flaws, scales or other imperfections, and provided with a heavy uniform coating of tin.

(*b*) Each solid conductor must stand an elongation of twenty-five per cent of its length in ten inches before breaking. In torsion it must stand before breaking thirty twists in six inches. It must be capable of being wrapped six times about its own diameter and unwound without showing signs of breakage after this

[1] Report presented to the convention of the Railway Signal Association, Niagara Falls, N. Y., October 12, 1905.

process has been gone through twice. The tension and torsion tests will be made on separate pieces of wire.

(*c*) The conductivity of the copper shall be determined by measuring the resistance of a length of the wire and comparing with Matthiessen's standard of copper resistance.

(*d*) Samples of the wire shall be thoroughly cleaned with alcohol and immersed in hydrochloric acid of specific gravity 1.088 for one minute. They shall then be rinsed in clear water and immersed in a sodium sulphide solution of specific gravity 1.142 for thirty seconds and again washed. This operation must be gone through with four times before the wire becomes clearly blackened.

(*e*) The vulcanized rubber compound must consist of not less than thirty per cent of the best grade of fine Para gum mixed with sulphur and dry inorganic mineral matter only. The insulation must be tough elastic, adhering strongly to the wire, homogeneous in character and must be placed concentrically about the conductor.

(*f*) The rubber shall be so compounded and vulcanized that when test pieces taken from the wire two inches between jaws and one-half inch wide where possible, are subjected to a tensile stress, they shall show a breaking strain of not less than eight hundred pounds per square inch and shall stretch to at least three and one-half times their original length. The jaws to be separated at the rate of three inches per minute. A piece of the rubber insulation four inches in length must be stripped from the wire and marks placed thereon two inches apart. The piece must then be stretched until the marks are five inches apart, two minutes' time being consumed in the elongation. Upon being released and allowed to contract, the original marks must not be more than two and one-half inches apart. The rubber insulation must be subjected for one hour to a temperature of 260 degrees Fahrenheit, using dry heat, and at the expiration of that time must be tested for elasticity, elongation and permanent set and must conform to the specifications therefor.

(*g*) The vulcanized rubber compound will be subjected to any chemical tests that may be necessary to ensure that only a proper grade of fine Para gum is being used and that no other ingredients are used in addition thereto except sulphur and dry inorganic mineral matter.

(*h*) The circular mils cross-section, the thickness of the rubber insulation (measured at the thinnest point), the minimum resistance in megohms per mile and the dielectric strength for the various sizes of wire shall conform to the following table:

Size. B. & S. Gauge.	Area in Circular Mils.	Thickness of Insulation.	Insulation Resistance. Megohms per Mile.	Test Voltage. Alternating Current.
0	105,592	2" wall or 1/8 O. D.	800	8,000
1	83,694	" "	860	8,000
2	66,373	" "	800	8,000
4	41,742	" "	840	5,000
6	26,250	" "	900	5,000
8	16,519	" "	900	5,000
9	13,090	" "	900	4,000
10	10,380	" "	900	4,000
12	6,530	" "	1,200	4,000
14	4,107	" "	1,550	4,000
16	2,583	" "	1,500	3,000
18	1,624	" "	1,500	3,000

The test for insulation must be made upon all wire without braiding, and after forty-eight hours' immersion in water at a temperature of from sixty-five to seventy-five degrees Fahrenheit. Tests must be made with well-insulated battery and galvanometer with not less than one hundred and fifty volts, and reading must be taken after one minute's electrification. The test voltage must be applied to the completed length of wire after the insulation test for a period of five minutes, using alternating current from a generator and transformer of ample capacity.

(*i*) The rubber insulation must be protected with a layer of cotton tape thoroughly filled with a rubber insulating compound, and lapped one-half its width. The tape must not adhere to the rubber and must be so worked on as to ensure a smooth surface. The outer braid must consist of one layer of closely woven cotton braiding one thirty-second of an inch thick, saturated with a black, insulating, water-proof compound which shall be neither injuriously affected by nor have injurious effect upon the braid at a temperature of 200 degrees Fahrenheit.

(*j*) Six-inch samples of wire with carefully paraffined ends shall be submerged in fresh water of a temperature of seventy degrees Fahrenheit for a period of twenty-four hours. The difference in weight of the sample before and after submersion must not be more than ten per cent of the weight of the sample before submersion less the weight of the copper and vulcanized rubber.

4. Packing and Shipping—The finished wire will be shipped on substantial wooden reels, the wire having been made in continuous pieces not less than 500 feet in length. Wire on reels shall be protected by burlap and where necessary by cleating. Both the wire and the reel must be tagged with cloth tags, showing the name of the maker, the size, length and order or inspection number.

It is recommended that the following shall be stipulated regarding tests:

The manufacturer must provide at his factory all apparatus and other facilities needed for making the required physical, chemical and electrical tests. Factory tests will be made under the direction of the railroad company's inspector upon notice from the manufacturer. The manufacturer shall give free access to the place of manufacture and opportunity to test at all necessary times. Tests will also be made upon the finished product after delivery, and the wire will be rejected if it fails to meet the requirements of any of the tests. The manufacturer must pay freight charges for return of all wire that may be rejected by the railroad company.

It is thought that the suggestions regarding the properties and tests of the copper conductors given above are not unduly severe, and yet give the purchaser ample protection. As regards the rubber insulation, this is the kernel of the whole matter, and unless this insulation is properly compounded, properly applied and properly vulcanized the wire is unfit for use in a signal system. It is a well-known fact that the desirable physical and electrical properties of insulation can not be secured without the use of rubber, real rubber, fine rubber, and plenty of it. The committee expects to be challenged for its suggestion that a compound be used containing nothing but Para gum, sulphur and dry inorganic mineral matter, and it will doubtless be claimed by many that the life of the insulation will be increased by the admixture of a certain amount of bituminous matter, or mineral wax. This has not yet been fully proven, but even if true, it is equally true that the admission of any such substance renders the purchaser practically powerless to determine the most important fact of all, namely, whether he is getting thirty per cent of a fine grade of Para gum in the compound. The question of course arises "why make specifications if they permit a product to be so made that it is impossible to tell whether or not the specifications are being followed?"

Any grade of Para gum permissible in a high-grade insulation will not contain more than 1.5 per cent of resinous extract which may possibly increase a vulcanization to as high as five per cent. This much in a compound containing thirty per cent of gum would yield 0.30 of five per cent or 1.5 per cent as the total percentage of resinous extract in the

compound. Suggestion has been made that by limiting the total amount of extract obtainable by acetone and alcoholic potash to five per cent of the compound that the proper grade of insulation would be ensured. The committee is, however, inclined to believe that even in conjunction with the physical and electrical tests the admission of five per cent extractive matter would permit the use of a lower grade rubber which might not have proper lasting qualities. The committee is inclined to seek a little further information on this point and have some tests made.

It is considered by some that the amount of free sulphur in the compound is highly important as affecting the copper and as permitting the process of vulcanization to continue under the action of any heat to which the finished wire may be subjected in use. The committee wishes to consider the value of this factor somewhat further before making a definite recommendation, and it may be that the dry heat test suggested may be of some service in determining the effect of free sulphur as well as in detecting readily the presence of partly combined resinous ingredients of low melting point when chemical facilities are not at hand.

It will naturally be asked "why are so many tests necessary?" and the answer is that cheap and useless compounds can be made that will pass almost any one or two of the tests. For example, many substances could be introduced to give a high insulation resistance, but which would deteriorate rapidly in service and the presence of which can easily be detected by the tensile strength of the insulation.

These and many other points lead naturally to the question as to how the purchaser at a distance from the wire mills is to be sure that his specifications are being lived up to. They must either be enforced or become a laughing-stock. The answer is that where any quality of wire is purchased the buyer should either send his inspector to the mills, arrange to use an inspector jointly with some other road or roads, or employ the service of some of the numerous inspection agencies or bureaus, which make a specialty of testing electrical material. Almost any signal engineer may, however, at slight expense get together simple apparatus for making most of the tests recommended except those for insulation resistance, and the puncture test, which latter require a more complicated and expensive equipment.

Naturally, it is possible to touch but briefly in the limits of such a report as this upon the great number of technical details of rubber manufacture, nor can one after a few months' study hope to speak on this subject with authority, but the committee feels that it has presented suggestions on which, with slight modifications, a proper specification can be based. It feels that the manufacturers can readily comply with such specification that the wire made thereunder will not cost too much, and that it will be safe and proper to use and worthy of the recommendation of the association.

A New Device for Railways.

Consul Mahin, of Nottingham, England, reports an automatic danger-signaling apparatus, to be used on railways. Theoretically, he says, the success of the new device is not doubted. Its practicability is questioned, however, because it may lead to carelessness on the part of those in charge of the trains. He writes:

"A resident of Nottingham has invented a system of electric signaling on railways, of which the principle, at least, its friends believe, will be eventually adopted by the railways. By an ingenious plan, when danger or the necessity of proceeding cautiously is signaled a gong would sound on the engine and an immense 'bull's eye,' on the cab, glare with red or green light in the driver's face. Even the densest fog, that greatest peril to English railways, would thus be robbed of its danger, provided there was no failure in the apparatus or supply of the electric current. Beyond the spot where, at present, the distant signal is located on the railways the invention proposes that a central rail 100 yards in length should be laid, with a second and much longer central rail near the present home signal. Connected electrically with the signal box, the pressure of a roller beneath the engine on these central rails would not only ring a bell and cause a lamp (corresponding with the track upon which the train was running) to glow in the signal box, but bells would ring, and red or green lamps glow on the engine itself, the color of the lamp depending upon which rail (the right or left) the signalman had converted into a negative.

"The theoretical soundness of the invention is not questioned, but doubts of its practicability are expressed. Engineers, it is feared, would lose alertness and rely absolutely upon the gong; and should the apparatus fail to work, hideous results might follow. Besides, the expense of proper generating stations would presumably be enormous. But the idea of electric signaling is in favor in railway circles, and this invention is a step toward its effectuation.

"Several years ago another Nottingham inventor devised a scheme for electric signaling, and constructed a model train and track to illustrate it. A copper-wire brush projected from each signal box. When the signal was placed at danger the brush caught upon a strip of copper extending the whole length of the model train, and caused a gong to ring on the engine and in the 'brake van' at the end. The model worked perfectly. Railway experts watched it, but somehow doubted the reliability of the scheme. One railway took somewhat kindly to it, but only offered to place a branch line at the inventor's disposal for experiment, he to install the system at his own expense. This he was unable to do, and his invention rests in abeyance.

"The dense fogs in winter and the attendant expense of employing extra men and means to avert disasters make the need of automatic signaling on English railways peculiarly imperative. Any practicable and relatively inexpensive system better than the methods now in use would be welcomed by them."

Tests of Osmium Lamps.

The following life and efficiency characteristics of osmium lamps are reproduced from the *Electrician* (London), September 22. The information was first published in a report issued by the Technologischen Gewerbe Museum, of Vienna. Tests were conducted on twelve lamps, six rated at sixteen candle-power, and six at twenty-five, both sets being for thirty-five volts. The lamps were divided into four groups, each group of three lamps connected being across a 105-volt alternating supply. The maximum illumination at right angles to the filament was measured every 100 hours, and the tests were conducted until the lamps failed. The diagrams represent graphically the behavior of two lamps of each size. They show that the efficiency and candle-power increase at first, and then drop slowly.

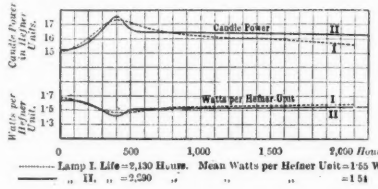

Candle Power
Watts per Hefner Unit
0
500
1,000
1,500
2,000 Hours.
Lamp I. Life = 2,130 Hours. Mean Watts per Hefner Unit = 1·55 Watts.
" II. " = 2,290 " " " = 1·54 "

FIG. 1.—TESTS OF OSMIUM LAMPS.

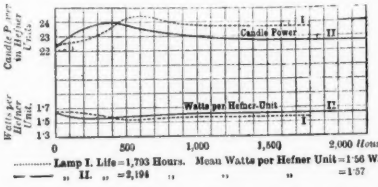

Candle Power
Watts per Hefner-Unit
0
500
1,000
1,500
2,000 Hours.
Lamp I. Life = 1,793 Hours. Mean Watts per Hefner Unit = 1·56 Watts.
" II. " = 2,194 " " " = 1·57 "

FIG. 2.—TESTS OF OSMIUM LAMPS.

"The Single-Phase Railway" and "Electric Railway Equipment."

AT THE Philadelphia meeting of the American Street Railway Association, now the American Street and Interurban Railway Association, Mr. Charles F. Scott presented a paper upon "The Single-Phase Railway." This paper was published in full in the issue of the ELECTRICAL REVIEW for October 7. Below is appended an abstract of another paper, read at the same meeting, by Mr. W. B. Potter, and an abstract of the discussion on both Mr. Scott's and Mr. Potter's papers:

"ELECTRIC RAILWAY EQUIPMENT."
BY W. B. POTTER.

Each year bears evidence of the growing popularity of electric traction and the increase in traffic has naturally affected both the size and weight of the cars and the schedule speeds.

The more onerous conditions imposed on the electric apparatus to meet the ever-increasing demand for larger and heavier equipments, and the demand for greater seating capacity on systems already operating at 500 to 550 volts, have led to an increase in the generated voltage. We have been accustomed to consider 500 to 550 as the standard direct-current voltage, but 600 volts is now being used to such an extent that it has really become the standard for the power station.

The rôle of the manufacturer is to design and construct such apparatus as will best meet the conditions of the operating companies and it is, therefore, the requirements of the operator that should be studied rather than the development of any particular idea.

The direct-current railway motor has been greatly improved and has undergone more changes in detail than is perhaps generally appreciated. The old troubles of sparking and flashing at the commutator have been practically eliminated. Previously it was considered advantageous to short-circuit a turn on the field winding to reduce the sparking at the brushes and in the controller, the idea being to restrain the rapidity with which the magnetism of the motor changed, but several years ago it was found that while this provision decreased whatever troubles occurred due to opening the circuit, that it was a positive cause of flashing in case the current was interrupted and suddenly applied. For example, this trouble would occur on passing a section insulator with the controller on, and more especially when operating with sleet on the trolley wire or running over a third rail with an uneven surface.

The field coils as now made not only have no short-circuiting turns, but where metal spools are used, it is customary to split the spool and introduce an insulation into the shell to eliminate every feature of a short-circuiting turn.

The armature revolutions of a motor as affecting the peripheral speed of the commutator have also an effect on the sparking and wear of the commutator. The armature revolutions further affect the performance of the bearings and while it would be possible to build a lighter and cheaper motor at higher armature speeds, a maximum of 1,500 revolutions per minute appears to be the highest desirable limit as indicated by experience.

To meet the requirements of the higher voltage now more commonly used, and to further ensure the stability of the motor as regards flashing, it is now the practice to provide a greater number of commutator segments; that is, the voltage difference per commutator bar has been reduced to a lower figure.

The commutator being a revolving switch, it is important, if sparking and flashing are to be avoided, that the brushes should maintain good electrical contact with the copper segments. The commutator being built up of alternate sections of copper and mica it sometimes happens that the mica does not wear evenly with the copper. In such cases the sparking becomes more pronounced and there may even be serious trouble from flashing; the most effectual remedy in such a case is to groove out the mica between the commutator segments to a depth of about one-thirty-second of an inch below the surface of the commutator. Many cases of troublesome commutation may be wholly cured by this expedient.

The performance of a motor for any service may be limited by its commutation or as is more commonly the case by its heating. The heating of a motor is affected by the losses in both the copper and iron, but the relative heating effect of these two elements is quite different. The copper losses predominate during acceleration and the iron losses when running at the higher speeds; the effect of the iron losses is, therefore, to limit the capacity of the motor for continuous running. Although the service in which motors are now commonly used does not call for a continuous run of many hours at full speed, without occasional acceleration, the iron losses are, nevertheless, of importance, and more care than formerly is now exercised in the selection of the iron for the armature. The principal cause of these iron losses is the eddy currents in the iron and to eliminate these a special study has been made of annealing and japanning the laminations.

While the temperature of a motor under given conditions is proportional to its internal losses, the actual temperature rise may be greatly influenced by ventilation to assist in dissipating the accumulated heat. Forced ventilation by means of a blower, similar to those used with air-blast transformers, may be employed. By this means the temperature of the motors in any particular service may be very much reduced, but the complication is such that it does not seem well adapted to the ordinary electric car. Forced ventilation is, however, well suited to locomotive work where the blower may be carried in the cab. As the motor commonly used depends upon its rotation for ventilation, the arrangement of the ventilating passages must be carefully studied, not only to secure the best cooling effect, but also to prevent depositing brake-shoe and carbon dust or other injurious material upon conducting surfaces of the motor which can not be conveniently cleaned.

For this reason it is inadvisable to provide ventilating ducts just at the back of the commutator ears, for any accumulation of conducting dust at this point is sure to produce burn-outs. It has also been found advisable wherever ventilating ducts are provided through the core head to extend the slot insulation of the armature coils for some distance beyond the end of the core.

The use of oil in preference to grease for the lubrication of motor bearings seems now to be universally favored. Of the various methods which have been tried, a waste-packed journal with an oil well, similar to the journal box of a car truck, has given the most satisfactory results. Nearly all the larger motors at the present time are designed for this method of lubrication.

The mechanical injury to motor armatures usually results either from the armature striking the pole-pieces or the mechanical weakness of the armature binding. The former, where resulting from the wear of the armature-bearing linings or loose cap bolts, can be avoided

by a proper system of inspection, but the latter is a question of motor design.

The strains to which the armature bindings are subjected, particularly if the car is speeded above the normal, by driving it with power down grade, are not ordinarily appreciated. As an illustration, the weight of the armature coils in a 125-horse-power motor is less than 200 pounds, and yet the radial centrifugal strain of all the coils at 1,500 revolutions per minute is about forty-eight tons, giving a resultant strain of over fifteen tons on the binding wires, and even if these wires are strong enough to hold the coils without breaking, they may stretch enough to permit a considerable movement of the coils in the armature slot, resulting in an abrasion of the insulation. An armature should be so bound that there will be no evidences of weakness at fifty per cent above the maximum normal speed, and the ultimate strength of the binding or bursting speed of the armature should be at least double the maximum normal speed to ensure the proper margin of safety.

The field coils of a motor, although subject to less potential than the armature, by reason of their location in the motor, are more subject to injury from occasional water. A distinct improvement has been made in the construction of the field coils by immersing them in a bath of hot compound under vacuum. The effect of this process is to thoroughly fill all air spaces with compound which not only renders the coil more waterproof but also makes it more solid and less liable to injury from mechanical vibration.

More attention is being paid to the fit of commutator and oil-well covers, which, being frequently opened, are now provided with machined seats in order to ensure a better fit for the exclusion of dirt and water.

With the increased capacity of the motors the strains on the gearing have very much increased, particularly on the pinion teeth which are of weaker section than the gear teeth. To meet these more severe conditions a very high grade of steel is required both with respect to ultimate strength and elastic limit. The grades of steel commonly used five or six years ago would by no means answer for the pinions of the larger motors built today. Not only are the strains severe, but owing to the overhang of the pinion, the face of both the gear and pinion teeth when new and doing heavy work is not in contact across their full width. The strain is borne principally by the end of the teeth nearest the motor, with the result that a shearing action takes place which will sometimes break out a part if not the whole of a pinion tooth. As a pinion wears the teeth become thinner on the side toward the motor so that a pinion which has been in service until its teeth match with the gear across the full face, may prove stronger under stress than a new pinion.

The solid axle gear is to be preferred to the split gear, and were it not for the inconvenience of removing the car wheel, would doubtless be more generally used. The objection to removing the car wheel for the reason that its fit on the axle is impaired, may be overcome by the use of a wheel with an extended hub, on which the gear is shrunk, as proposed by Messrs. Doyle and Brinkerhoff and in use on the Interborough, New York.

The more severe demands of present service have also necessitated changes in the older type of controllers, as well as the development of new types of control and control appliances. The cylinder controllers have been improved by making the arc deflectors of a more vitreous material, less affected by the arc and productive of a much smaller quantity of conducting gas when opening the circuit under abnormal conditions.

For the control of equipments aggregating 200 horse-power and over, the type M control, consisting of electrically operated contactors or switches, is recommended and is being very generally used. It is not only possible to handle heavier currents and a higher voltage by contactor switches, but a further advantage lies in the fact that the master controller occupies considerably less space than a cylinder controller handling the full motor current.

Whether the cars are operated singly, or in trains as the Sprague-General Electric multiple-unit system, the control may be either hand operated or automatic in its action; in the former case the handling of the master controller is similar to the ordinary cylinder control, and there are controller notches corresponding to each rheostatic step and the series and parallel running points. In the automatic control there are only three positions of the handle, the first one giving slow movements to the car for switching; the other two points being the series and parallel running positions. The intermediate rheostatic points are actuated automatically by a series relay on each car of the train. The automatic form of control is well adapted for services where the rate of acceleration may be predetermined and need not be dependent upon the judgment of the motorman.

For automatically protecting the equipments from the results of accidental short-circuits it was the early practice to provide fuses consisting of a composition of lead and tin; and although magnetic fuse boxes were used, their action with this type of fuse was not always satisfactory. It was partly for this reason and because of the time required to replace fuses, which with the older types of equipment were more frequently blown, that the automatic circuit-breaker came into quite general use. On the larger equipments, however, where the circuit-breakers had to be set for 1,000 amperes or more, it was found difficult to provide space for them in a position where the arc resulting from a short-circuit would be free from danger of grounding to some part of the car. As a substitute for the circuit-breaker in this heavier class of work, many different forms of fuses have been tried, but none has proved thoroughly reliable with the exception of a fuse composed of thin copper ribbon enclosed in an insulating chute and surrounded with enough iron to provide a magnetic field. This copper ribbon fuse has been quite generally used on the larger equipments for the past few years and has given excellent satisfaction. The same type of fuse is applicable to smaller equipments and in many cases it may be found superior to the circuit-breaker, as its reliability is a strong point in its favor. A circuit-breaker should have frequent inspection and in case of several repeated short-circuits it may be so injured as not to finally extinguish the arc without an amount of flame that may alarm the passengers.

It is a matter of favorable comment that the car wiring is now receiving much more attention than formerly. Those familiar with the character of work formerly done, will readily testify to the advantages secured by eliminating the dangerous practice of attaching the wires by staples or other means to any convenient place on the underside of the car and often without regard to the movement of the brake-levers and compression of the springs of the loaded car. The best recognized practice is now to install all wiring in iron conduit and if properly done with the ends of the pipes fitted with bell mouths or other provision to avoid abrasion of the wire, the car wiring should prove the most safe and permanent part of the electrical installation.

The suggested improvements in wiring

apply with even greater force to the lighting and heating circuits, as these circuits have generally been given less attention than the motor circuits. As a source of fire, the lighting and heating wires are dangerous on account of their location in the roof or sides of the car, their inaccessibility for inspection and the fact that current is often left on these circuits when the cars are in the car barn.

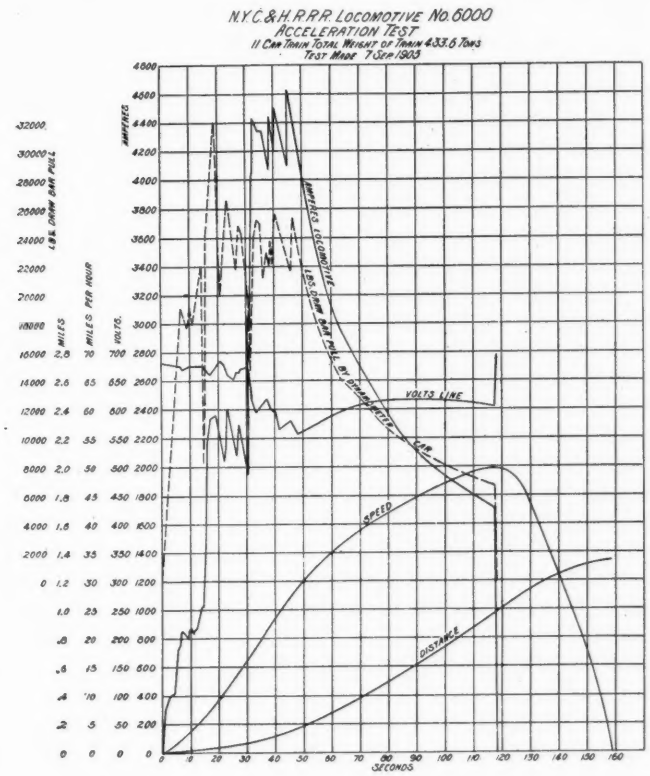


FIG. 1.—ACCELERATION TEST, ELECTRIC LOCOMOTIVE.

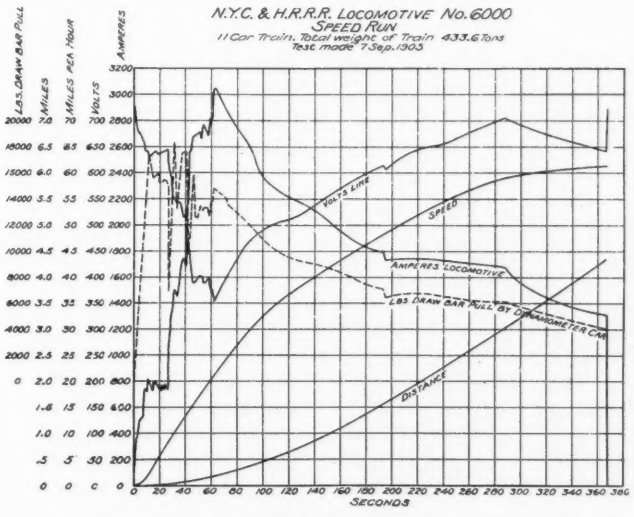


FIG. 2.—CURVES OF SPEED RUN, ELECTRIC LOCOMOTIVE.

While many of the preceding remarks have been based more particularly on the experience with direct-current apparatus, the essential principles apply equally to the alternating-railway equipment.

During the past year there have been several installations of alternating-railway equipments and the outlook is very promising for this class of equipment under conditions advantageous to its use. Considered wholly from a technical standpoint there is no question but that alternating-current motors can perform any service now done by direct-current apparatus, but the choice, as between alternating and direct current, should not be made without a full consideration of the direct and indirect expense incident to either type of equipment.

As the street railways and the steam railroads are now becoming so closely identified, a reference to some of the recent tests of the New York Central electric locomotive will not be out of place. This locomotive has now run over 21,000 miles with trains of varying weight. The maximum speed attained with a train weighing 278 tons, including the locomotive, was seventy-one miles per hour in a distance of about four miles. With the locomotive alone the maximum speed was eighty-five miles per hour, with the probability that the speed would have been 100 miles per hour had the run been twice the length.

The accompanying curves show tests made with an eleven-car train, including the New York Central dynamometer car, which were made for the purpose of checking the results obtained from the speed-torque characteristics of the motor.

Fig. 1 shows an acceleration test, all the records of which were taken with automatic recording instruments. The draw-bar curve was taken by the dynamometer car, with no damping device or dash-pot to control the fluctuations on the recording pointer. The comparative steadiness of the pull of the electric locomotive will appeal to those who have seen a dynamometer record, without the damping device, taken from a steam locomotive.

Fig. 2 shows the curves of a speed run over the test track with the same train. The notch in the curve at about 190 seconds is caused at that point by the locomotive leaving an additional strip of third rail which was fed from some distance away.

The total weight of this locomotive is ninety-seven tons, of which about seventy tons is on the drivers. The nominal rated power is 2,200 horse-power, although the output during acceleration has often exceeded 3,000 horse-power.

DISCUSSION.

W. E. GOLDSBOROUGH.

To my mind the alternating current is destined to play a most important part in railroading. Presumably, there will be no large electrification of steam railroads in the sense of miles of track extending across the country in which the system will not be used in some form. I think that the electrical fraternity, and particularly the operating companies, owe a great deal

to the courage of the manufacturers of electrical machinery. I do not know that we can look back to any other period in the development of the art in which the manufacturers have taken so great a load off of the shoulders of the consumers.

When it comes to the question of maintenance of equipment, I feel that we should step aside and look the ground over carefully before we throw out direct-current equipment for alternating-current equipment. When you have a very large number of equipments operated on a rather restricted mileage, then you are confronted with a condition wherein maintenance is an important factor, and there is no question but that at this time it is much cheaper to maintain a direct-current system (I mean maintain the motive power equipment) than to maintain the alternating-current motive power equipment. On the other hand, if you are confronted with a great deal of mileage, and relatively small number of units running over the mileage, then maintenance is a matter of secondary consideration, and you can take long chances in the matter of maintenance, for the reason that you are saving so much investment in copper and substations and other things. I believe each of these problems is going to be met by the engineer and solved by the engineer, not for the sake of having a new thing—and we must grant the American engineer and the American people generally are enthusiastic for new things—but for the practical utility of these things. As thoughtful men we should discard any consideration of these things because they are new, but look upon each problem from an engineering standpoint, and use the direct-current apparatus in those places for which it is best adapted. However, without the alternating-current apparatus, it goes without saying that the enormous expansion which is to take place in electric railroading in this country would be utterly and entirely impossible.

C. O. MAILLOUX.

The principal lesson conveyed to me by some of the papers, and especially by this one of Mr. Scott's, is that we shall not go too hastily, and it teaches also the importance of good engineering, not only from the standpoint of the manufacturer, but more particularly from the standpoint of the operating company. It is sad to contemplate and realize, but unfortunately it is true, that there is too little engineering done by the operating companies. While I have much faith in the single-phase system, I do not believe that the direct-current motor or the direct-current system is to be put on the shelf forthwith. I was recently called in consultation with two other engineers by the power committee of a board of directors in regard to the new equipment of a road. I found that those who had undertaken to do the engineering for that company had received their inspiration more from the manufacturer's interest than from the study of the interests of the operating company, and had recommended an alternating-current system of generation and distribution with direct-current substations. I looked over the case carefully, and I said: "Don't, don't make that mistake; stick to direct current." I found that a director of the railroad company, who was himself operating an electric lighting plant in the same city, was in favor of the alternating-current system, having been converted by the manufacturer's engineers, though he himself was operating on Edison three-wire direct-current system. He had never understood the real inwardness of the situation until I explained to him and his colleagues that in their particular case the electrical "centre of gravity" of the system was within two miles of the station. That is, if you take the total car-miles for the heaviest day (and the heavier the day the more strongly the fact was shown) their centre of electrical distribution was at an average distance of something like one and three-quarters miles from the power station, and over seventy-five per cent of the car-miles was within the city limits and within a radius of six or seven miles. Gentlemen, I characterize the attempt to foist on that board of directors a system of alternating-current substations as foolish, to put it mildly, and I believe that such a thing will react on the manufacturers. That was a striking case, a splendid example where it will pay the company to have had its engineering done for it on its own account and at its own cost. . . . The single-phase alternating-current motor will greatly enlarge the field of operation of the companies operating the direct-current-motor system, by enabling them to extend their lines in the suburbs. In the particular case to which I have just alluded, I told the gentlemen that even granting the possibility that they may some time or other want to go as far as twenty-five miles, it would still be better for them to generate their power current with direct current and transform what little portion of it might be wanted into alternating current for their suburban lines, which in car-miles represent only a relatively small percentage of the whole system.

W. B. POTTER.

There are several inherent features in the single-phase alternating-current motor which influence the question of maintenance, and to which I will briefly refer: the magnetism of the motor, like the current by which it is produced, is alternating in character and develops differences of potential in the windings of such a degree and character as to be more liable to prove injurious to the windings than in the case of the direct-current motor. For instance, should a single turn of the field winding in a direct-current motor become short-circuited on itself, the effect would be simply to eliminate one turn of the field coil; while in an alternating-current motor a similar short-circuit would cause that turn to act as a secondary of a transformer, and a large local current would be produced within the short-circuited turn, which would soon burn out the coil. The alternating magnetism also produces within the armature coils an electromotive force which injuriously affects commutation and necessitates special provision being made to secure results comparable with direct-current practice. A feature essential to the commutation of the alternating-current motor is an additional field winding, known as the compensating winding, which is wound through the face of the pole-pieces midway between the ordinary field coils, and serves to neutralize the armature reaction. In addition to this compensating winding in the fields the motor armature is sometimes provided with what are called high-resistance leads between the armature coils and the commutator. The effect of these leads is to diminish the local current in the armature, caused by short-circuiting adjacent commutator segments by the brush. The location of the compensating winding in the pole faces renders it liable to injury in case the armature core should strike the pole-pieces, and the presence of high-resistance leads may, under some circumstances, result in severe local heating and burning out of the armature. The magnetism of the motor, owing to its alternating character, is of less average density than in a direct-current motor, with the result that for a motor of given dimensions and output the armature speed is considerably higher. To keep the armature speed within the limits that direct-current experience has shown to be advisable as affecting the performance of the bearings and a proper contact of the

brushes with the commutator, it is necessary to make the alternating-current motor of larger size for the same output. The characteristics of an alternating-current motor, particularly the power-factor, are affected by the air gap between the armature and pole-pieces; better results being secured with a smaller gap. The alternating-current motors, as ordinarily designed, have an air gap of about one-half that commonly used in direct-current motors of the smaller sizes, and even a less percentage of air gap in the large motors. We have, therefore, a tendency toward higher armature speeds and a smaller air gap, coupled with a field winding wound in the pole faces, conditions which necessitate a more frequent and careful inspection of the motors or else more frequent and expensive injuries to repair. It is probable that the maintenance of the control and other appliances will not differ materially from that of a direct-current equipment. The maintenance of the car equipment is, however, not a controlling factor in the cost of operation, and if it should be doubled, or even trebled, the alternating-motor maintenance may be far more than offset by the reduction in fixed charges resulting from a lower first cost of the proposition considered as a whole. The conditions which demand more frequent inspection, particularly of the motors, may presumably be a cause of more frequent interruptions in service; hence the importance of giving the alternating equipment more attention than is customary with direct-current motors must not be overlooked. Improvements in detail will, undoubtedly, be made, and the motors will be strengthened and improved in such features as may develop a weakness, but there appear to be certain inherent conditions, some of which I have mentioned, which can not be wholly eliminated in the alternating-current motor as we know it to-day. I would also call attention to possible interference with telephone and telegraph lines which may result from the installation of an alternating-current trolley adjacent and parallel to such circuits. The telephone lines, having a metallic circuit, are more subject to electrostatic influences, the effect of which it is possible in some degree to eliminate. The telegraph lines having, however, a ground return may have developed within the circuits sufficient electromotive force to seriously affect the working of the instruments. A metallic return with the circuits frequently transposed, as is common in telephone practice, may prove an efficient remedy. An alternating control of the single-phase motors differs from that of direct current, in having a transformer or compensator carried on the car as a medium for supplying the motors, instead of using the fixed voltage of the trolley line. The secondary windings are provided with taps giving different voltage, and each point of the controller is, therefore, an efficient running position, and, furthermore, additional taps may be provided in the secondary to give higher voltage than the normal running potential. This higher potential serves to give a higher speed to the car for making up time or to compensate for any abnormal drop in the trolley voltage.

THE AMERICAN INVASION OF CHINA.

BY GEORGE W. K. HARTMAN.

Much has been said and written concerning the American invasion of China and the Chinese boycott of American commodities; but if his far-off cousin is as wily and as quick to appreciate American methods and innovations as the Chinaman of San Francisco, then the danger is not very great. It did not take long to popularize the gas stove and incandes-

THE "CHINATOWN" OFFICE OF THE SAN FRANCISCO GAS AND ELECTRIC COMPANY.

THE "CHINATOWN" OFFICE OF THE SAN FRANCISCO GAS AND ELECTRIC COMPANY.

cent burner among them, and upon its heels, the electric light. They were so well received and the demand was so great that the San Francisco Gas and Electric Company found it advisable to establish an office in the heart of Chinatown.

Surrounded by queer Chinese nut-oil lanterns and curious oriental sights and sounds (and smells), the two electric signs, the one in Chinese meaning "The Old Company," stand out oddly in the night.

The interior view of the office shows the Chinese manager and one of his clerks. The office is conducted on modern American methods, as the telephone would indicate.

San Francisco's Chinatown also boasts of its telephone exchange, with hundreds of subscribers and Chinese "hello" boys.

Statistics for the city show that the Chinese burn per capita more gas than the white population.

Wireless Telegraphy and Ships in Distress.

The following interesting communication has been forwarded by the Atlantic DeForest Wireless Company, giving a striking illustration of the practicability and value of the equipping of vessels with wireless apparatus:

(COPY.)

Port Arthur, Texas,
October 12, 1905.

S/S "CAPT. A. F. LUCAS."

Mr. Hughes,
42 Broadway, N. Y.

Dear Sir:—On Monday morning October 9th, at about 7 o'clock, I was listening in when I heard the "City of Everett" calling for assistance. I at once called them and ascertained their position. We found them in a sinking condition. We stood by them for twenty-nine hours, giving them some heavy planks and some iron bolts and sheltered them from the rough sea by standing between them and the wind. They at last succeeded in pumping all the water out and proceeded to New York. We then started on our way to Port Arthur.

The "Everett" had the door of the forward turret washed away on the forward hold. The only damage we received in that storm is one of my wires on the mast is broken. I can receive alright but it hangs crooked and better be fixed when we get to New York. Everything else is O. K.

Yours truly,
(sgd.) ALBERT L. HEIMBECKER,
Operator.

LETTERS TO THE EDITOR.

Incandescent Lamp Ratings.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I wish to congratulate the ELECTRICAL REVIEW on the thoroughly reasonable argument upon the present methods of rating incandescent lamps. For a number of years the writer has given a great deal of attention to the candle-power rating of incandescent lamps. You will remember, without doubt, that the writer was the first one, apparently, to call the attention of the public and the technical press to the difference in the value of incandescent lamps by reason of the direction in which they deliver their light. To rate incandescent lamps by the readings taken in the direction in which the lamp delivers the most light, and not to consider the light emitted in other directions, is now accepted by almost all thinking people to be an error. There is, however, an inclination to adopt the mean spherical measurement, which would be practically as bad, for the reason that a room might be equipped with a lamp capable of generating and delivering 1,000 candle-power, and yet the illumination of that room not be at all satisfactory for ordinary purposes. A searchlight, placed in a position in which the flux of light would be delivered through the window or directly upward, might not be as satisfactory, although the rating of the lamp itself were 1,000 candle-power, as the light delivered from an incandescent lamp delivering a flux of light equal to thirteen candles.

During the past six years I have discussed these matters with many of the leading professors of electricity and physics in the various universities, and find that in a majority of cases they agree that the useful light of the incandescent lamp is that delivered through the end of the lamp or within an angle of forty-five degrees therefrom. Dividing the area of the lamp into zones of fifteen degrees each, I believe that the proper rating of an incandescent lamp for ordinary purposes would be the mean quadrazonical candle-power; that is, the light delivered through the lower four zones, namely, at ninety degrees on the vertical, seventy-five degrees, sixty degrees and forty-five degrees, working toward the horizontal.

A lamp might have a mean spherical rating of several hundred candle-power and still, as before stated, deliver the light in such a direction or be built in such a manner that certain obstructions would prevent the light from doing any service on the objective plane. I have found in my experience that in many instances the users of artificial light have provided a sufficient amount of light for their own satisfaction and comfort; and the installation of reflectors simply increases the light upon the objective plane to a degree so much above that that can be utilized in vision that the light is as much wasted as it would be were it to be delivered upon the side walls, as in the past, when reflectors have not been used.

Practically all manufacturers of incandescent lamps are recommending lamps that deliver the light down. They are getting away from the candle-power rating altogether. The recent advertisement of one of the largest manufacturers, calling attention to certain very efficient light units, does not make any claim of the horizontal distribution, but claims an efficiency of two and one-half watts per candle-power, stating in the advertisement that the lamps should be designated by number and not by candle-power. It is a remarkable fact that this particular light unit, which consists of an incandescent lamp with a reflector, does not deliver light in any direction at the efficiency of two and one-half watts, which is the efficiency claimed. If the unit, which I repeat, consists of an incandescent lamp with a reflector, is measured horizontally, we find the efficiency considerably lower than three watts per candle-power. If the candle-power rating is taken vertically, then it is practically a one-watt-per-candle-power lamp, but there is no position in which this lamp will measure two and one-half watts per candle-power.

The great fear that appears to exist among manufacturers of lamps is that the vertical light will be considered. I believe that all lamp specifications should provide that the mean lower hemispherical candle-power should not be greater than the mean horizontal candle-power, and from our viewpoint I believe it would be better yet to specify that the lower quadrazonical candle-power should not be greater than the mean horizontal candle-power.

Incandescent lamps should be purchased in order to perform a certain purpose; that purpose being to produce satisfactory illumination with the least consumption of current in a certain length of time. The mean horizontal reading can not, under any condition, be correct, because it would be ridiculous to advise users of lamps to use the lamp in a horizontal position except in a very few instances. The base would necessarily cast a shadow within the line of vision, and the

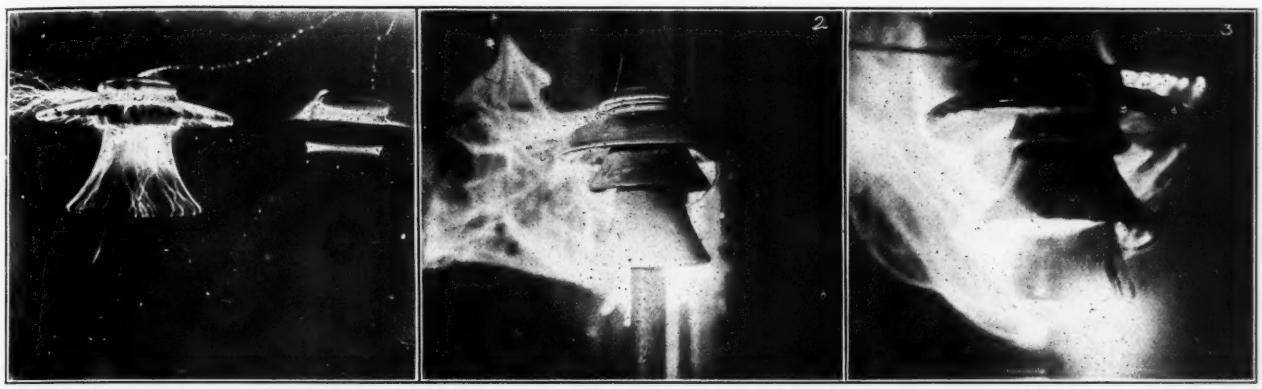
appearance of a lamp used in this position would be much against it.

I have been advocating the useful-light type of lamp for six years. I am now more firmly convinced than ever that this type of lamp has advantages over those of other types. If the rays of light travel in direct courses, as they certainly do, and lamps have been delivering a sufficient amount of light on the objective plane to give entire satisfaction, it is absurd to claim that twice the volume of light, required upon the objective plane, where are situated the objects upon which one desires to concentrate his attention, should be thrown upon the side walls, where one only cares to rest the eyes. If the light delivered through the end of the lamp is sufficient by which to read, a similar quantity of light should certainly be sufficient upon the walls. This is now acknowledged by practically every lamp manufacturer who has his salesmen recommend the use of reflectors, which only change the direction in which the light is wasted. The human eye can only receive a certain volume of light without injury, and there are more eyes ruined by reason of too high a degree of illumination than by reason of an insufficient illumination. When the manufacturers agree that reflectors are an advantage, they, by this decision, acknowledge that the light upon the side walls is not necessary. I claim that this light, if unnecessary, should not be generated; that the current used in its production should be saved and that the illumination of the objective plane should be satisfactory with an even distribution of light throughout the entire area to be lighted.

I agree with you perfectly that a number of small units placed high are much better than a smaller number of larger units.

J. C. FISH.

Shelby, Ohio, October 9.



HIGH-TENSION DISCHARGES AND THE "DARK FLASH."

Electrical Discharges Showing the Dark Flash.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

Your issue of September 2 contains a very interesting article on "dark flashes" of lightning, for the cause of which no satisfactory explanation has been offered. As an addition to this subject, we are sending several photographs of insulators under test, some of which show the same dark lines as are plainly seen on the photographs of lightning discharges.

Photograph No. 1 shows two large insulators under 180,000 volts, and the lines are caused by static and brush discharge of the ordinary blue or purplish color, unaccompanied by any yellow or power arc.

Photograph No. 2 shows an insulator about which a heavy power arc is playing, producing the white fanlike effect, but at the right will be seen the "dark flash," evidently not produced by ordinary discharge, since from photograph No. 1 it is evident such a discharge ought to reproduce the same color as the arc.

Photograph No. 3 shows a curious mixture of light and dark lines, which it hardly seems could be static in any form since the insulator was thoroughly wet all over and approximately 200 kilowatts of energy was being expended in the arc.

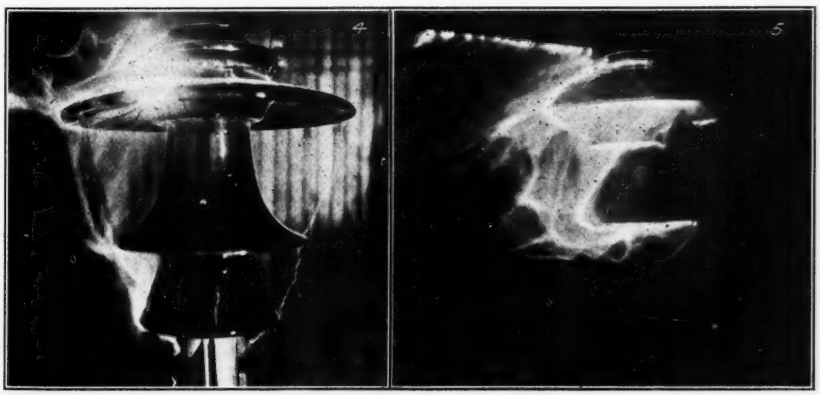
Photograph No. 4 shows a Toronto-Niagara insulator under dry high voltage test, and plainly shows light and dark lines.

Photograph No. 5 shows an ordinary insulator under wet test. No black lines are in evidence.

All the above photographs were taken practically instantaneously; *i. e.*, the camera was opened in the dark test cabin and potential quickly applied to the insulator, causing the arc to form and by its draught of current opening the primary circuit-breaker.

THE LOCKE INSULATOR MFG. CO.

Victor, N. Y., October 17.



HIGH-TENSION DISCHARGES AND THE "DARK FLASH."

The Southeastern Iowa Independent Telephone Association.

The annual meeting of the Southeastern Iowa Independent Telephone Association was held at Fairfield, Iowa, October 10, 1905. The presidential address was delivered by J. C. Thorne, of Fairfield. Following the roll call, papers were read as follows:

"Reorganization," S. S. Lichty, Vinton; "Clearing-House Methods," Charles C. Deering, Boone; "Party Lines," W. D. Dunsmore, Oskaloosa; "Toll Lines and Service," Frank McNally, Washington; "Are Our Rates in Harmony with Our Investment?" Howard Herr, Ottumwa; "Our Association—What Is the Ideal?" O. H. Seifert, Eddyville; "What of the Future?" J. S. Bellamy, Knoxville.

Electric Smelting in Canada

The Canadian *Manufacturer* prints the following interview with Doctor P. L. T. Heroult, the French metallurgical expert, who is now visiting the Dominion:

"In ten years Canada will have become a great metallurgical country. You will see an iron industry in this Dominion larger than in any other country in the world. Canada will yet furnish to the world its iron supply. It will be just the same with iron as with wheat. A decade from now Canada will outstrip all other countries in wheat growing. The production of iron at a cheaper rate than it can be made elsewhere will cause Canada to take a similar position as far as iron is concerned."

The foregoing prophecy was made, not by a Canadian, but by a visitor from France, Dr. P. L. T. Heroult, technical director of the French Electrometallurgical Society, which has immense works at La Praz, France, where aluminum and steel are produced. Doctor Heroult is perhaps the best living authority on the smelting of iron ores and the manufacture of steel by the electric method. He has invented the process which is named after him. Two great plants for the refining of steel by the Heroult process are in course of construction, one in Germany and the other at Syracuse, N. Y. The latter is being erected by the Holcomb Steel Company, which has obtained a license from Doctor Heroult to use his invention. The cost of the works will be $1,000,000, and the output will be from eighty to one hundred tons daily. The company purposes to manufacture tool steel and also high-class billets. The Holcomb company will be the first concern on the American continent to use electricity in connection with the making of steel. It will be produced by the ordinary method, and the electricity will be applied to a purifying or refining process.

The great metallurgical expert will not give all his time to the Syracuse enterprise. He has undertaken to superintend experiments in the making of pig iron and steel at a plant which is now in course of construction at Sault Ste. Marie, and for which parliament, on the Hon. Frank Oliver's recommendation, voted $15,000. Associated with him will be Doctor Haanel, superintendent of mines. It was on Doctor Haanel's advice that the Hon. Clifford Sifton, when minister of the interior, despatched a commission to Europe to study and report upon the electric process of smelting ores and making steel. Doctor Haanel personally conducted the commission, which was fraught with great consequences to Canada.

FEASIBILITY OF THE NEW METHOD.

When the commission reported upon the feasibility of the electric method there was a universal demand from all parts of the world for the report, which received the highest commendation from scientific authorities. From that date public interest in electric smelting became intensely keen, and plants for the utilization of the new method were started in various countries. In Europe and in the United States, where fuel is cheap, the ordinary processes can be utilized for refining. In the extreme west of Canada fuel does not cost much, but in the interior the price is prohibitive. This is especially true of Ontario and Quebec, where there are immense deposits of magnetite. These ore bodies have long remained undeveloped because they could not be economically treated. But in their vicinity is water power in abundance, and that means cheap fuel. Doctor Heroult has smelted magnetite by electricity, and it is a success. He is reasonably sure we can produce pig iron and a high-grade steel here. But to make certain beyond all peradventure, and to ascertain all the facts that can be learned in connection with electric smelting experiments for six months, will be conducted at the "Soo" in a plant of special design and construction. Doctor Heroult thinks that under favorable conditions pig iron can be made for $10 per ton, while steel will cost only about $4 per ton more to produce. This means a saving of several dollars as compared with the cost of producing pig iron and steel elsewhere. But even if the cost were the same as in other countries it would mean great things for Canada.

When asked what the successful smelting of iron ores would mean to Canada, Doctor Heroult said: "Pig iron is the basis for structural and other steel. At present Canada expends $50,000,000 and $60,000,000 in buying steel abroad. The idea ought to be to make that steel in this country out of Canadian material by the aid of Canadian water power and Canadian labor. Even if the cost of making iron and steel here should only equal the cost elsewhere you would keep in Canada the money you now send abroad. But we expect the cost of manufacture will be less here. Think of what it means. The retention in Canada of $60,000,000 now yearly spent abroad, the supplying of the new demand for steel rails, structural steel and other classes of the product which have arisen in consequence of the country's development, the profitable sale of your surplus products in foreign markets, and the creation in this country of numerous other industries more or less dependent upon iron and steel. As to the iron resources of this country, from all that I can learn, they are vast indeed. In Sweden the quantity of ore is sufficient to supply the markets of the world for one hundred years. If we were to compare the quantity in Canada with that in Sweden I should say Canada has three times as much."

The New Ocean Liner Amerika.

The Hamburg-American Line has placed in commission its new liner, the Amerika, built at the yards of Harland & Wolff, Belfast, Ireland. This ship has a length of nearly 700 feet overall, a breadth of seventy-four feet six inches, and a depth of fifty-three feet. Her displacement is about 42,000 tons, and her gross tonnage about 23,000 tons. Loaded, she carries 16,000 tons of cargo. She has accommodations for 3,400 passengers, and carries a crew of 600, making a total capacity of 4,000. The ship is provided with the most modern and luxurious staterooms and lesser accommodations, and there is an à la carte restaurant as an adjunct to the regulation service.

One of the most recent innovations in ship architecture is the use of the electric passenger elevator. The Amerika is the only ship afloat with a passenger elevator, and this elevator serves the five decks of the ship.

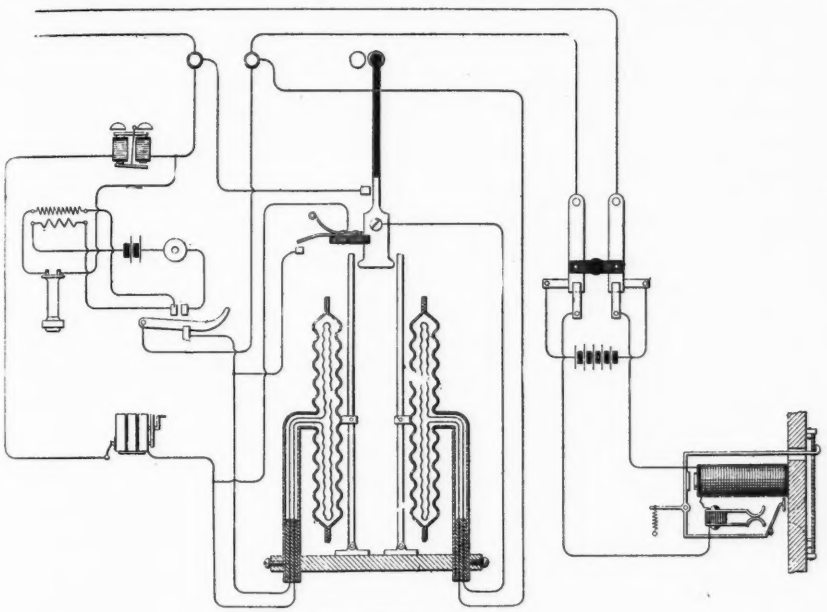
Other features of the new ship include Marconi wireless telegraph apparatus, stateroom telephone service, electric baths and a system for communicating through the water between the ship and the shore. By the use of this system the navigator can find, by bell signals, the location of lightships and lighthouses, regardless of weather conditions. A system for closing the water-tight bulkheads is also in use. By pushing a button on the bridge, it is possible, in a few seconds, to close the water-tight doors of every compartment into which the hull of the ship is divided. Protection against fire is provided by the newest extinguishing system —that of forcing sulphuric acid gas into the threatened premises, smothering the flames.

The Amerika is driven by Harland-Wolff quadruple-expansion engines of over 15,000 horse-power, built on the balanced principle.

The Amerika made her first trip last week, arriving at New York, Friday, October 20.

Electrical Patents.

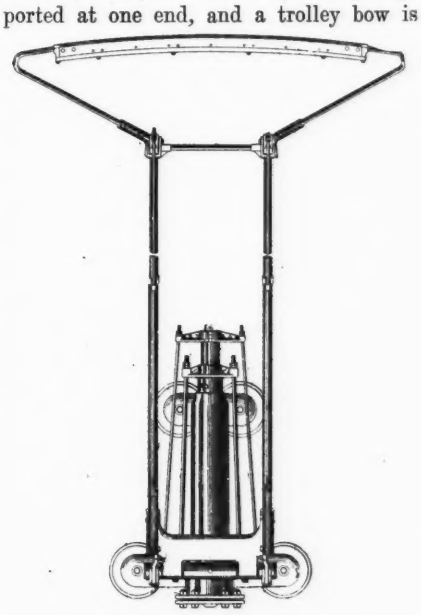
Charles E. Egan, of Chicago, Ill., has assigned by mesne assignment the entire interest in a patent obtained by him on



TELEPHONE SYSTEM.

a telephone system to the Egan Electric and Telephone Manufacturing Company, of Petersburg, Ill. (801,778, October 10, 1905). The invention relates to improvements in telephone systems in which a number of telephones are arranged on a single circuit, and the object is to provide a simple means whereby the operator at the central station may cut out the coil and bell circuits of all the intermediate telephones while conversation is held between two subscribers at the remote stations, thus reducing the resistance in the talking-circuit. In carrying out the invention, a circuit controller is employed comprising a metal plate adapted to form part of the circuit. Chambers are arranged in the circuit and have corrugated expansive inner walls. Swinging rods have connection with these walls, and are adapted to operate a circuit controller. Heat coils are located in the chambers, and means are provided at a central office for controlling the heat coils.

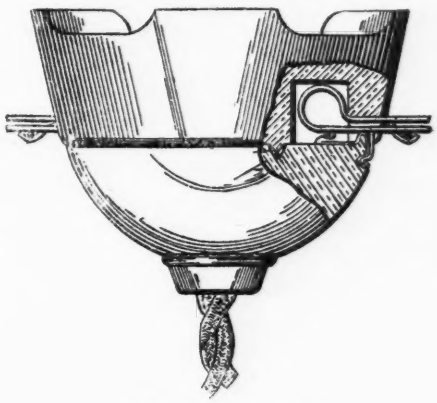
A trolley and trolley support has been devised and patented by Harry P. Davis, of Pittsburg, and Christian Aalborg, of Wilkinsburg, Pa., assignors to the Westinghouse Electric and Manufacturing Company (801,225, October 10, 1905). The object of the invention is to provide a trolley which will successfully collect the current from a trolley conductor when the car to which it is attached is propelled at a high speed and which will automatically adjust itself to variations in the height of the trolley conductor without liability of disengagement therefrom. It is also the object to provide means for raising and lowering the trolley and its support and for ensuring good contact between the trolley and the trolley conductor, which may be controlled from the motorman's cab. In the embodiment of the invention, a frame is pivotally supported at one end, and a trolley bow is



TROLLEY AND TROLLEY SUPPORT.

pivotally supported upon the free end of this frame. A fluid-pressure actuated piston is provided, also connections between this piston and the frame and between the piston and the trolley-bow; each of the connections having a resilient element whereby the trolley structure is yieldingly supported to accommodate it to different elevations of the trolley conductor.

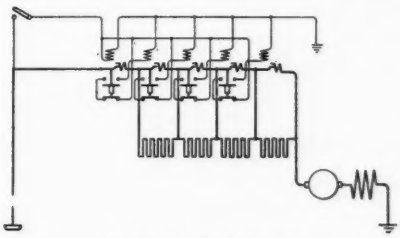
An improvement in that class of devices known as "rosettes," which are in the nature of insulating blocks adapted for attachment to the ceiling or wall and provided with means for connecting electrical circuits and also fuse wires for safety purposes, is the invention of James A. Mebane, of South Boston, Va. (800,-



ELECTRICAL ROSETTE.

586, September 26, 1905). In the rosette disclosed in the present invention, a cap is employed which is provided with V-shaped ribs extending from the centre outward to a point near the periphery, and a V-shaped point extending inward from the periphery and lying between the first named ribs, thus forming a circuitous passageway for the fuse wires.

The General Electric Company controls a patent on a control apparatus, granted to George H. Hill, of Schenectady, N. Y. (801,239, October 10, 1905). The invention relates particularly to control apparatus for electric motors, comprising a plurality of individual switches



CONTROL APPARATUS.

or contacts, some of which are arranged to be actuated in automatic progression. A plurality of electromagnetically actuated main switches are provided, and a normally open and a normally closed auxiliary switch is arranged in the actuating circuit of one of the main switches. A connection is arranged between another main switch and the normal open auxiliary switch, whereby the latter is closed when the main switch closes. A connection is also located between the latter main switch and the normally closed auxiliary switch, whereby the latter switch opens and closes when the main switch closes.

Reviews of Current Engineering and Scientific Literature.

Choke Coils.

This one of a series of articles on protective apparatus, by Mr. N. J. Neall, deals with choke coils used as auxiliaries to lightning arresters or other high-voltage discharging devices. Choke coils are made in two forms—spiral or helical. The former is the one most frequently met with, as it gives the greatest proportional effect. A recent investigation into the properties of choke coils has shown that the greater part of the choking action is due to skin effect. It was found that with fifty feet of wire, No. 8 and No. 9, that about eighty per cent of the choking action was due to skin effect, and about twenty per cent to the inductance of the wire. For larger wires this result would be modified. The greatest choking action is obtained from coils using relatively small wire in a maximum of length and a flat spiral form. A new type of coil brought out by the General Electric Company has a helical form, contracted at the centre. It is thought that this contraction adds to the inductance of the coil. An important requirement of a large choke coil is that it shall possess sufficient surface of ventilation to keep the insulation unimpaired by heating. It must also have the insulation so placed as absolutely to prevent side flashes at the time of the disturbance. A Westinghouse coil recently designed with these objects in view has a flat form, the several layers consisting of numbers of small wires, each layer being separated from the adjacent ones by insulating strips arranged so as to leave an air space between the turns. During an investigation of static phenomena, made by Mr. P. H. Thomas, it was found that switching, short-circuits, grounds, etc., produce a strain on the terminals and transformers and other apparatus. For this reason it has become customary to introduce choke coils into the leads to the apparatus, rather than in the line wires. A new type of choke coil recently brought out by the Westinghouse company, intended for high voltages, is wound in flat form and submerged in oil. In addition to this coil there is a high-voltage condenser. In use, two coils are placed in the two line wires, and two condensers are connected directly across the wires, their intermediate point being carried to the ground. This arrangement secures the effect of a larger coil, and a consequent reduction of strain on the transformer terminal. Tests show a very great gain in the use of the condenser. In fact, disturbances set up by short-circuiting the system were only about one-eighth as great as when the apparatus was not inserted in the circuit.—*Abstract from the Electric Journal (Pittsburg), October.*

Apparatus for Dissipating Fog and Smokes.

M. A. Breydel here discusses briefly his investigation into the dissipation of fogs by means of electrical discharges. It was found that a fog containing dust or smoke is more easily precipitated than one consisting of pure water. It is supposed that the solid particles are more easily charged by a radiator, and are then propelled away from it, precipitating any particles of vapor they may collide with. It was found that the best type of radiator is one consisting of a bundle of spikes, similar to the Melsen lightning-rod tip. With these radiators a sphere some metres in diameter can be cleared in a few seconds. For practical uses it is suggested that the radiators might be mounted on lamp-posts along the streets. The apparatus required is inexpensive, and the power necessary is small. The latter may be furnished to the radiators from a static machine driven by a motor; or, better, from a small transformer, itself fed from the alternating-current lighting circuit, and mounted in proximity to the radiator. The two terminals of the high-voltage side of this transformer should be connected to two radiators. Where a dissipating system is to be carried on shipboard, the radiator should be mounted on a mast inclined forward from the bow of the vessel at an angle of about forty-five degrees. The same system is applicable to trains.—*Translated and abstracted from L'Éclairage Électrique (Paris), September* 23.

A Large Electric Crane.

A description is given here of a mammoth crane which has been erected at Durban, Natal, for handling large concrete blocks which are to be used in building a sea wall. The crane has a travel of 1,435 feet. The width of the span is 135 feet. It lifts twenty tons at the rate of ten feet per minute. The traveler that runs on the top of the gantry weighs over ninety tons, and is equipped with four motors working at 500 volts. These motors have been specially designed for crane work, and run in either direction without requiring shifting of the brushes. The controllers are of the railway type, and the conducting cables are lead-covered. Current is collected by the traveler from two trolley wires supported on brackets fixed on the inside of the gantry, immediately under the rail. The hoisting motor is rated at twenty horse-power, the cross-traverse motor at twelve horse-power, and two forty-horse-power motors are mounted, one at each end of the traveler, for the longitudinal travel. These motors are so arranged that they will give six speeds of travel from 100 to 300 feet per minute. All the motors have gravity brakes connected in series with their fields. In addition, the hoisting motor has both foot and hand brakes. The crane itself weighs about ninety-five tons, and the height from the ground to the rail is twenty-two feet.—*Abstracted from the Electrical Review (London), October* 6.

The Calculation of Mean Spherical Candle-Power.

A simple method of calculating the mean spherical candle-power is described here by Mr. Launcelot W. Wild. The accuracy obtainable depends on the number of angles at which the measurements are taken, but an accuracy of about one-half per cent can be obtained from measurements taken every thirty degrees. In the usual method of computing the mean spherical candle-power from angular measurements, a curve is constructed on a base equal to the diameter of a circle, and the ordinates are the several candle-power measurements. This area is then integrated, and the average value is taken as the mean spherical candle-power. It is simpler, the author holds, to compute separately the areas of these several trapezoids. This can be done without constructing the figure by taking the average of adjacent measurements of candle-power and using a proper multiplying factor, which factor consists of one-half the difference between the sines of the two angles at which the measurements were made. These multiplying factors are given in a table for every thirty degrees, every fifteen degrees and for every ten degrees. In all cases the sum of the multiplying factors is unity. The chief error in this method is made at the angles of plus and minus unity, but since the areas here are small, the error is slight. Since the sum of the multiplying factors is always equal to unity, the error due to a true spherical dis-

tribution of light would be nil. On the other hand, with an irregular distribution, such as that given by an arc lamp, the error might be considerable. The method, however, is not put forward as suitable for use with arc lamps, but merely for determining quickly the mean spherical candle-power of incandescent lamps.—*Abstracted from the Electrician (London), September 29.*

The Ratio between Thickness and Dielectric Strength of High-Tension Insulating Materials.

In a previous article, Mr. C. Kinzbrunner discussed methods of testing insulators for dielectric strength, and explained the system which he had adopted in order to obtain satisfactory and concordant results. In this article Mr. Kinzbrunner gives the results of an investigation made to determine the relation between dielectric strength and thickness of insulation. The tests were carried out in the manner described in the previous article. Many samples of material were obtained and tested between flat electrodes with round edges. The pressure of the electrode was one-quarter kilogramme per square centimetre. The alternating voltage employed was nearly sinusoidal. The frequency of the alternating current was between twenty and seventy-five cycles per second. The temperature was about seventeen degrees centigrade, and the humidity was about seventy per cent. The time of testing was fixed according to the quality and thickness of the material. Results of a large number of tests are given. The materials were not previously dried, and the relation between the dielectric strength and thickness of the material was found to follow approximately a quadratic law. It was found that with pressboard of given thickness, the dielectric strength varied with the square of the number of layers. With paper, dielectric strength seems to vary directly as the number of layers. With very fine paper, the curves are practically straight lines, and become more and more bent the thicker the paper. Varnished paper was found to follow closely the performance of ordinary paper. Impregnated paper—that is, paper which has been soaked in an insulating liquid—behaves nearly as thin paper; that is, the dielectric strength is proportional to the number of layers of paper, and, for a single layer, proportional to the square of the thickness of the material. The following laws are deduced from this work: the dielectric strength of most insulating materials—Para rubber excepted—is proportional to the square of the thickness. The dielectric strength of insulating materials—paper excepted—consisting of several layers of the same material, is nearly proportional to the square of the number of layers.—*Abstracted from the Electrician (London), September 29 and October 6.*

Electricity in a Match Factory.

A very complete description is given here by Mr. G. P. Low of a large match factory situated at Chico, Butte County, Cal., and owned by the Diamond Match Company. The electric drive has been adopted throughout the factory, but its use involves nothing particularly new. In the engine room there are two horizontal engines, each directly connected to a 400-kilowatt generator of the Bullock type, which furnishes current at sixty cycles, three-phase, 440 volts. The exciting current for the generators is supplied from a fifty-horse-power motor-generator set. There is, in addition, an auxiliary unit consisting of a horizontal engine direct-connected to a seventy-five-kilowatt Bullock three-phase generator. The special applications of the electric motor in this factory are in handling lumber and fuel. Fifty horse-power in induction motors is used in handling the lumber. A twenty-horse-power motor is employed to unload the green timber from the flat cars. A twenty-horse-power motor reloads the dried timber on cars as it is taken from the kilns, and a ten-horse-power equipment unloads the green lumber from the cars prior to its distribution in the yards. The unloader for handling the lumber as it is taken from the cars consists of a movable apron, counterbalanced so that it can be accommodated to the height of the pile of lumber. This is approximately twenty-five feet wide, and carries four sprocket chains with steps, which travel in a direction at right angles to the length of the car. The car, as well as the unloading machine, together with the transfer cars, tables and tracks, is roofed in. The lumber is carried up this apron at a speed of 120 feet a minute to the sorter's table, where it is sorted by lengths into the proper one of nine channels. The plank is stood on edge in these channels, and is carried forward on rollers to a table, where it is dumped in front of the proper kiln car. The dried lumber, as it comes from the kilns, is handled in a similar way, with the exception of the sorting process. When the lumber is not to be dried at once, it is unloaded from the car by an apron machine of a different type. This carries the lumber down a long distributing table, from which it is taken and stacked. The fuel employed in the factory is sawdust and wood scrap. This is supplied to the boilers by a blower system, belt-driven by electric motors. The system is driven by three motors—one rated at 100 horse-power, one at forty horse-power and one at thirty. These drive, respectively, a thirty-six-inch, a twenty-inch and an eighteen-inch blower. In the planing mills all motors are located in the basement. A 200-horse-power motor is belted to the main countershaft; a seventy-five-horse-power motor drives the band re-saw, and a twenty-horse-power motor drives the sandpapering machine. There are a number of other motors rated from forty to twenty horse-power. In the machine shop there are two forty-horse-power motors, one driving the main countershaft, and the other a 220-volt, direct-current generator for supplying current for the shop cranes. There are two cranes, one able to lift ten tons, and the other, fifteen. The lighting load of the different factories at present in operation amounts to about 100 kilowatts. Two new factories are now being erected, in which will be installed over 400 horse-power in additional motors. By the time these have been put into service, the total power-load will reach about 1,150 horse-power.—*Abstracted from the Journal of Electricity, Power and Gas (San Francisco), October.*

The International Exposition at Milan, Italy.

In order to appropriately celebrate the completion of the Simplon tunnel, an international exposition, under royal patronage, will be held in Milan, Italy, from May to November, 1906. Practically all of the European countries and several of the Asiatic nations will participate officially. In the transportation section, retrospective exhibits will show the historical development of the various modes of travel. The dominant feature will be motion. All products, as far as possible, must be shown in connection with the processes, thus filling the halls with moving exhibits. One large building will contain all forms of welfare work, grouped under several heads.

Milan is the centre of the most productive section of Italy. Its population is 1,500,000, while Lombardy, no part of which is more than three hours distant, has more than 5,000,000 inhabitants. Genoa, the port of entry, is less than 100 miles distant. The cost of transporting exhibits from the United States will be comparatively small. Terms for space and other information will be given on application to J. H. Gore, George Washington University, Washington, D. C., or L. S. Ware, 54 Rue de la Bienfaisance, Paris, France.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

Some very unusual and striking advertising has been running during the last few weeks in the daily papers of Boston, Mass. As it lends itself to commendation to an unusual degree, we reproduce here-

ELECTRICITY

Of all the power developed by steam in Boston 50 per cent is used to drive shafting and belting —dissipated, wasted, before the work of the machine begins. Think of it! All the money paid for the coal which makes that wasted part of the power might as well be thrown into the sea for all the good it does. With electric power, you use what you need, when you need it, where you need it. A turn of the switch puts it there.

Have you learned to be power-wise?

The Edison Electric Illuminating Co.
3 Head Place, Boston

with some of the advertisements exactly as they have appeared.

The salient feature of this advertising is that it possesses great simplicity, combined with strength, and it has elicited a large amount of favorable attention in and about Boston because it is entirely different from any other advertising that has ever appeared in the Hub. Advertising of this character can not but make not only converts for electricity in its various branches, but it is believed this form of advertising can not fail to aid in strengthening the bonds between the public and large corporate interests. This consideration should be a factor of the greatest importance in any up-to-date corporation advertising. It is free from any taint of cheapness or overstatement, and the truthful tone underlying and pervading the entire series of advertisements will make new friends for the Edison Electric Illuminating Company.

The designing of this series of advertisements was in the competent hands of Mr. Converse D. Marsh, who is the advertising adviser of the Boston company.

The preferred positions, that is, the most prominent positions in each of the papers in which the publicity is running, have been secured, and the advertisements have been carefully selected with reference to the clientele of each of the newspapers employed.

The days of the week on which these advertisements were inserted have also been carefully looked into, preference being given to the evening papers on Mondays and Saturdays, while the insertion of any advertisements on Sundays has been avoided.

The theory in the method underlying the employment of the evening papers is

ELECTRICITY

in your home will just about cut out the fire hazard. Lace curtains and light weight draperies are not endangered by the Electric Light. Yet the lamps will glow wherever, whenever, you want them, bringing light into any dark places. Have you learned to be light-wise?

The Edison Electric Illuminating Co.
3 Head Place, Boston

that on Monday afternoons the afternoon papers are read with unusual interest, since there has been no issue of them for the forty-eight hours preceding the Monday issue. The Saturday editions of the evening papers have been selected because this day's issue is always a good home issue.

The Sunday papers have been avoided by reason of their blanket form, and the fact that the electrical advertisements do not occupy large space. Mr. Marsh believes that a small advertisement should be omitted, if possible, on Sundays, unless it has special reference to business to be secured on Monday, or there is some other special reason for the employment of the Sunday editions.

The morning papers are used on different days of the week with the exception of Monday, so that every other working day of the week finds the Boston Edison's advertisement in at least one paper.

The value of the campaign is illustrated by its being copied elsewhere; but in order to avoid errors, the central station should be very sure that the form of advertising it adopts is particularly adapted to the locality in which it is to appear. It would not do to recommend this particular form of advertising in, say, San Francisco, nor can any form of advertising be adopted until careful consideration is given to the bulk of the advertising appearing in the newspapers of any one city. The idea should be, in newspaper advertising, not only to carry force and conviction, but to have the layout and general artistic or mechanical features strikingly different from the mass of advertising in the mediums used, in order

ELECTRICITY

—Your name—the name of your product—will be simply burned into the consciousness of every passer-by if an Electric Sign is working for you after dark. The brightest streets are the busiest streets—the lightest stores the busiest.

Have you learned to be sign-wise?

The Edison Electric Illuminating Co.
3 Head Place, Boston

that the dissimilarity may seize the wandering eye.

But, when you have secured that eye, avoid all exaggerated statements as carefully as you shun an exaggerated display or "circus" type and methods, if you would command the respect of, and convince the reader of the advertising.

INDUSTRIAL SECTION.

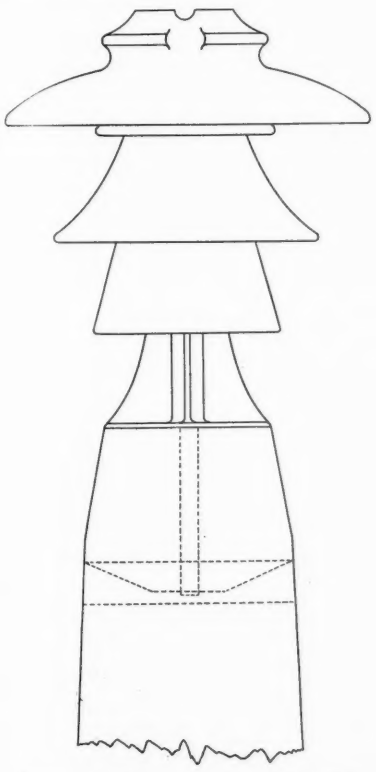
ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

A New Insulator Pin.

The Locke Insulator Manufacturing Company, Victor, N. Y., has recently placed upon the market a new pin which,

NEW INSULATOR PIN.

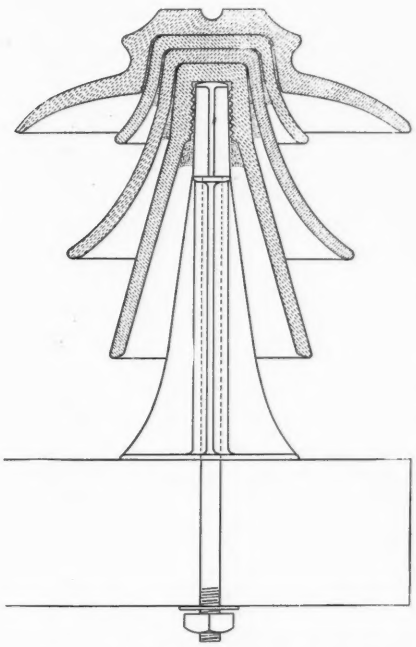
for iron wood pole construction, is considered an advance over the ordinary malleable iron truss.



OUTLINE OF INSULATOR AND NEW PIN.

As shown, the pin as a whole consists of an iron base and central steel bolt, the top of the bolt being webbed to facilitate the cementing on of the insulator, the bottom being threaded to allow firm attachment to the cross-arm. That portion of the bolt immediately under the web, the lower ends of which are machined so as to form a perfect seat upon the base, is threaded to fit a similar thread in the base, thus intimately uniting the two parts of the pin.

Upon any other type of pin the manner of application of forces depends upon the direction of the forces acting on the insulator. However, in this method of construction, all forces, no matter how applied to the insulator, are always resolved into tensional and compressional upon the



SECTION OF INSULATOR AND NEW PIN.

same parts; that is, the central steel bolt is always under tension, while the supporting iron base is always in compression. At the very top of the bolt, where the stiffness of the bolt must be depended upon, maximum strength is secured by webbing and firmly securing the webbed portion upon the base by means of the thread.

Attachment is made to the cross-arm in the ordinary way, and under no condition can the pin become loosened without being visible to the inspector from below.

A modification of this type of pin presents a novel solution of the pole-top pin proposition for, as will be seen by reference to the illustration, the addition of a special nut allows of its ready application to the pole-top with none but the simplest tools.

This type of pin is the result of considerable work along the line of pin construction, and when the uncertainties of malleable iron are taken into consideration its advantages, the maker believes, become apparent.

Some New Electric Signs.

The Haller Machine Company, 127 Fulton street, Chicago, Ill., is the designer and builder of a line of attractive

LETTERED SHIELD.

electrical signs modeled to suit the ordinances of the city of Chicago.

During the last five years the electrical sign business has grown with leaps and bounds. The underwriters and city inspection departments have watched the

OLD ENGLISH LETTERED TABLET.

growth of this part of the electrical business, and in many cities there have been passed ordinances compelling the manufacturers to limit their apparatus to the specifications which have been considered safe by the authorities under whose

SCRIPT LETTERED SIGNBOARD.

jurisdiction the placing of signs and the wiring of this form of apparatus might come. That these signs can be built according to such specifications, and present an attractive appearance, is evidenced by the exhibit of the Haller Machine Company.

The Blake Signal System.

At the recent railway convention at Philadelphia, Pa., one of the exhibits which attracted a great deal of favorable recognition from street railway managers was the Blake signal system for electric and steam railroads. This system is manufactured by the Blake Signal and Manufacturing Company, 246 Summer street, Boston, Mass. The system is in no wise intended as an automatic block system, but it is ingeniously adapted to provide a method by which the despatcher can signal his cars at any desired point, and communicate by telephone the necessary way orders.

Already electric railways have made use of the telephone as an adjunct to the traffic department. In most cases, however, it has been necessary for the car to stop at each telephone box and for the conductor to call up the despatcher's office and ask for instructions. If the way be clear, and if there are no instructions for the car, this is obviously a waste of time, and an imposition upon the passengers. The car mileage is also cut down, and in several ways this system has been regarded as inefficient.

The function of the Blake signal system is such that the despatcher can set a signal against a car at selected points, the conductor, upon seeing this signal, calling up the despatcher and receiving instructions direct. This makes it possible to keep a car running by the regular sidings, and gives the despatcher direct control over the movement of any of the cars on the system.

It is not only in the direction of mechanical simplicity, however, that this system is so attractive. The method by which the signals are controlled is one of the features of the system. The mechanism of the signal is entirely independent of the telephone apparatus. The idea upon which the system is based occurred to Mr. C. C. Blake, vice-president and general manager of the company, in 1903. Mr. Blake made use of different lengths of pendulums energized by electromagnets, for obtaining signals that could be selectively operated from a central office without a complicated system of wiring. The Boston & Worcester Railway was the first road to establish this signal system. After watching the behavior of the signals for a year, it was decided to make up special tools and to create extensive shop facilities for turning out a number of signals for the market. The signals, as turned out to-day, are essentially similar to those originally used on the Boston & Worcester Railway. They have, however, been improved in certain details of mechanical and electrical construction, and standardized so that all parts are readily removable or interchangeable.

The apparatus consists of despatcher's office equipment, shown in Fig. 3, and the line semaphore signals, each signal containing an electromagnet and pendulum. These are exhibited in Fig. 1 and Fig. 2. These signal pendulums vary in length, and each one corresponds in length to one of the pendulums in the despatcher's office. The despatcher's office equipment consists of a desklike box containing pendulums of different lengths and platinum contacts, which are made and broken by the swing of the pendulum at intervals varying with their length, and capable of transmitting corresponding impulses over the line (consisting of a single bare iron wire) which influence only that signal on the line which the despatcher desires to operate.

The basic principle of the signals is that the time of vibration of the pendulum varies with its length; therefore, if,

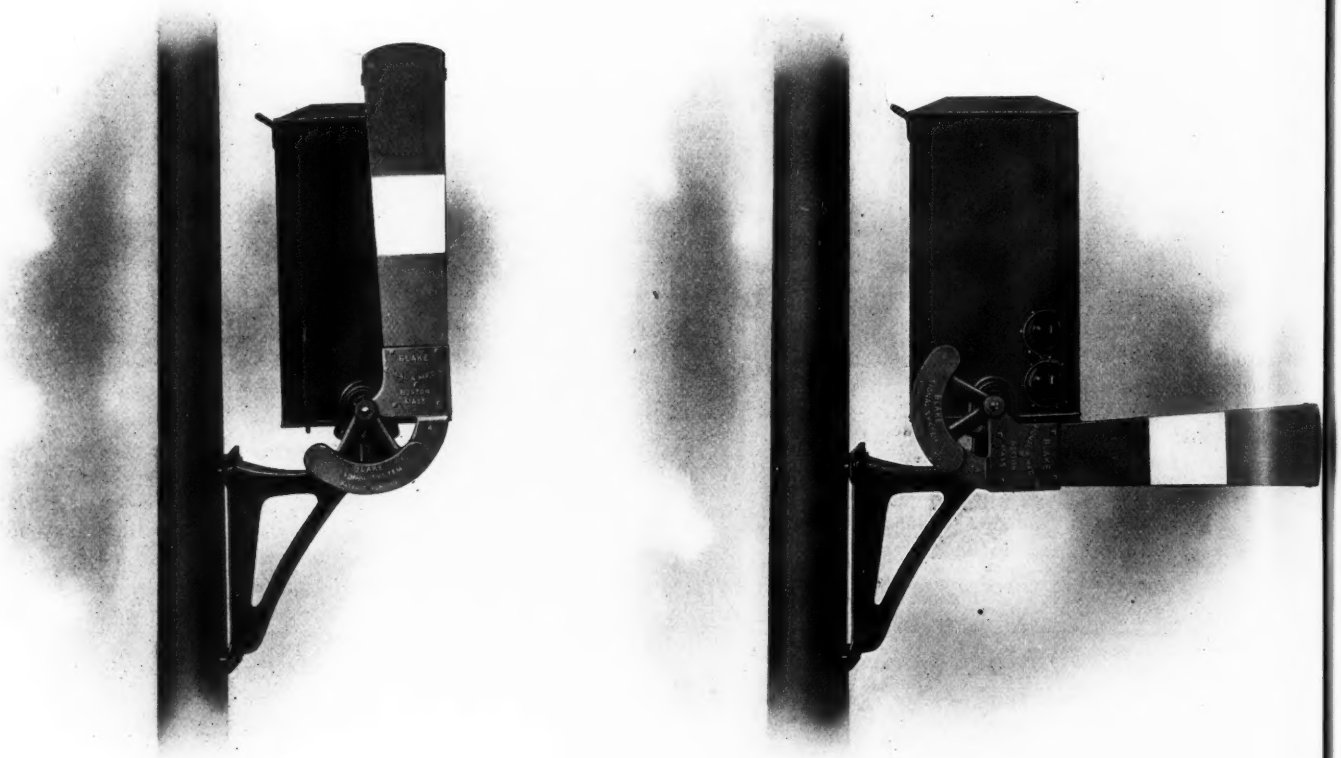


Fig. 1 and Fig. 2.—Semaphore in Vertical Position, and Semaphore in Horizontal Position, Blake Signal System.

at some central point, such as a despatcher's office, a pendulum is put in vibration, as it opens and closes an electric circuit, impulses will be set up in that circuit synchronous with the vibrating pendulum, and depending upon the length of the pendulum. On only one signal, however—that one whose pendulum is of the same length, and therefore synchronous with the vibrating pendulum in the despatcher's office—will these magnetic impulses be of a proper period to be cumulative in effect. This cumulative effect will swing the pendulum in an ever-increasing arc of vibration. The pendulum which is receiving the cumulative effect of the synchronous vibrations reaches a certain amplitude and mechanically trips a lock, releasing a three-foot semaphore arm, which falls to the horizontal position by gravity. Having reached a horizontal position, this semaphore closes the local signal lamp circuit, and also closes a shunt to ground on the signal line, causing a sounder to be affected in the despatcher's office, and notifying him of the fact that the signal has operated.

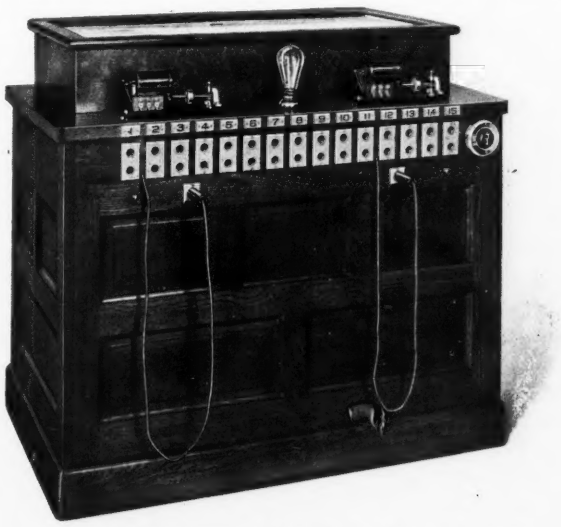


FIG. 3.—DESPATCHER'S BOX, BLAKE SIGNAL SYSTEM.

The manufacturers claim that when the signal is properly set up and adjusted, it is impossible for any signal to be operated other than the one selected. There is a positive answer back to the despatcher, indicating that the semaphore arm has been set in the horizontal position, so that until the arm has reached an angle of about forty-five degrees, it is impossible for him to get this answer, and the danger of a false signal is eliminated.

The power for operating the signal is obtained entirely through the despatcher's office, and there is no local circuit at each signal other than the signal lamp circuit. There are no electrical contacts in series with the operating magnets at the various signals. The signal line is electrically continuous throughout from the despatcher's office to the return circuit at the end of the line. If one signal lamp burns out, a second lamp is automatically cut in circuit. The second lamp is in an interrupted circuit, and gives a flashing light, so that any crew can report this detail and a new lamp may be put in at once.

Patents for Circuit Protective Apparatus.

Fourteen patents have recently been issued to Charles A. Rolfe, bearing date of October 3, 1905, and these have been assigned to the Rolfe Electric Company, Rochester, N. Y. The patents are all for electric circuit protective apparatus.

Two of these, Nos. 800,822 and 800,825, are for enclosed fuse devices; and the remainder are for sneak current arresters, which have become generally known as electrical circuit protectors.

The two fuse patents cover structural improvements in enclosed fuses, by which it is claimed they can be made more economically, will give better satisfaction and last longer.

Of the protector patents, all but two, Nos. 800,820 and 800,821, are for self-soldering apparatus. The two above mentioned are for a plug form of protector—the protector constructed as a removable plug which fits into a board or frame just like a telephone switchboard plug. The protector plug can be removed and replaced by hand at will.

The ten remaining patents show a great variety of self-soldering apparatus. Nos. 800,823 and 800,824 show the self-soldering principle applied in a protector for short-circuiting the circuit when operated, instead of opening it. Patent No. 800,823 shows an individual protector operating on this principle, and No. 800,824 a bank or terminal board of the same kind.

Patent No. 800,826 is for a self-soldering protector which is arranged to automatically shunt the line and ground the circuit without opening it, as opposed to short-circuiting the circuit, as in the previously mentioned patents.

Patents Nos. 800,827 and 800,828 are self-soldering apparatus in which the protector is in shunt across the terminals of the instrument, so that one protector is sufficient for the circuit or each end of it, instead of two as is now the practice. Patent No. 800,827 is for a bank or rack of such protectors and No. 800,828 for an individual protector.

Patent No. 800,830 is for a self-soldering protector in which the self-soldering mechanism is in the line-spring, instead of on the heat cartridge. The line-spring has a solder joint which simply buckles to permit operation, and is then automatically restored and resoldered.

Patent No. 800,829 is for a form of self-soldering heat cartridge which can be employed in protector racks constructed to receive the old form of heat coil having a solder-secured pin which was pulled out when the device operated.

Patents No. 800,831 and 800,832 show two different styles of protectors having the self-soldering principle applied in two still different ways. No. 800,831 has a coupling arrangement with an automatically resoldered pin, and No. 800,832 has a self-soldered catch holding the movable trigger which engages the line-spring.

Patent No. 800,833 is for the double trigger protector having a heat cartridge with a double ended pivoted lever which is self-soldered in a tilted position each time, so that the cartridge is reversed to permit the line-spring to engage it again.

Westinghouse-Parsons Steam Turbines in Municipal Service.

The public lighting commission of the city of Detroit, Mich., has placed an order with the Westinghouse Machine Company, of East Pittsburg, Pa., for a 2,000-kilowatt, turbine-type generating unit; following this order shortly afterward with a second order for a machine of the same size.

The two new units will be installed in the original building, replacing some of the older rope-driven machinery. The turbines will be of the standard Westinghouse-Parsons type, operating at a boiler pressure of 160 pounds without superheat with a normal vacuum of twenty-eight inches. The generators will also be of standard Westinghouse design, of the revolving-field type and with the enclosed generator frame construction.

It is announced from London that the "Long-Arm" System Company, Cleveland, Ohio, has been awarded a gold medal for its Earl's Court exhibit of "Long-Arm" electrically operated power doors for ships. This was one of the few displays of American devices in the Naval, Shipping and Fisheries Exhibit.

New Incandescent Lamp Portables.

The accompanying illustrations show two new fixtures manufactured by the O. C. White Company, Worcester, Mass. Fig. 1 shows the new adjustable portable lamp especially adapted for use either on the top of a roll-top desk or for lighting a flat desk or for distributing light over the keyboard of a typewriter. This lamp has a universal scope of adjustment, and is adaptable for any position. The base is entirely new in design and construction, and is large and heavy, affording a substantial support for the lamp and shade, even on extreme leverages. The joints are of japanned iron and finished gun metal, and the lamp arm is of heavy brass tubing.

Large sizes of electric cord can be readily used with this portable. Protection from abrasion is afforded at every point by insulating bushings of hard fibre.

Fig. 2 shows the new strap clamp desk fixture designed for direct attachment to a roll-top desk. Except for the strap clamp, the construction is identical with the adjustable portable lamp. The joint embodies entirely new mechanical principles, and permits turning, dipping and sliding adjustments to any position or angle by frictional tension secured at one point of fastening. The standard wrist joint at the end of the lamp arm gives a free angular adjustment to the lamp.

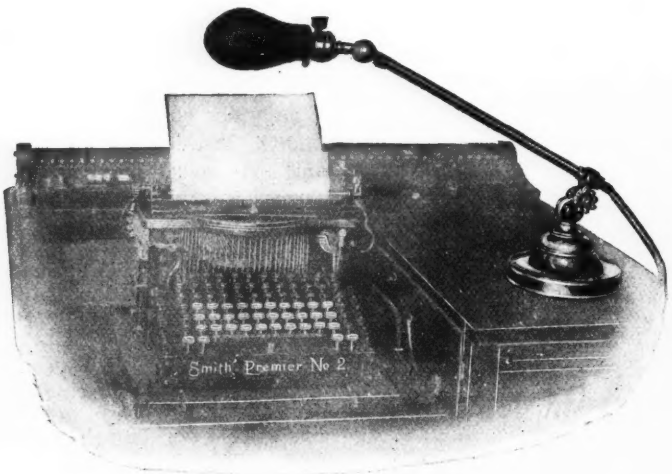


FIG. 1.—DESK PORTABLE, FOR TYPEWRITER'S DESK.

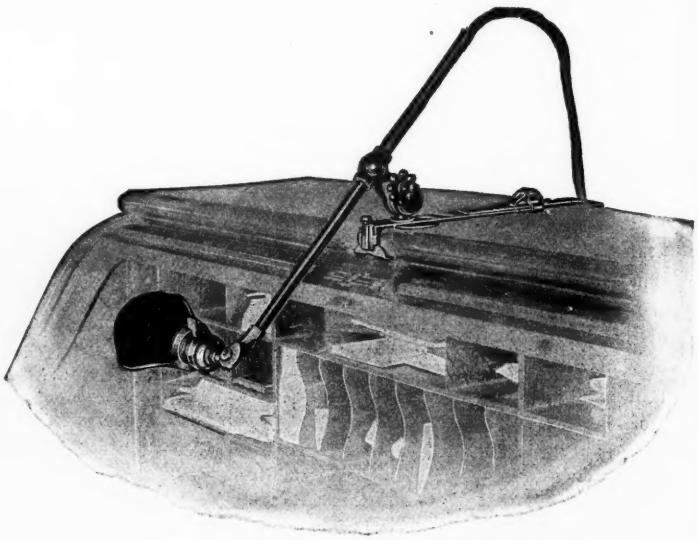


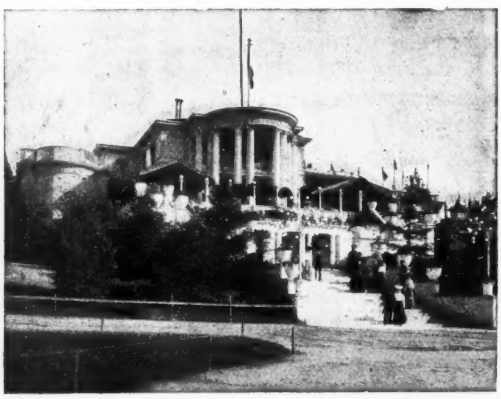
FIG. 2.—DESK PORTABLE, FOR ROLL-TOP DESK.

General Electric Company Awards at Portland Exposition.

Announcement is made that the superior jury at the Lewis & Clark Exposition has approved the following awards in the electrical department, relating to the exhibits of the General Electric Company, Schenectady, N. Y.

The highest award granted by the jury is a gold medal. This company received a gold medal for its exhibit in the electrical department and also gold medals on each of the following features of this exhibit:

Curtis steam turbine. Meters and instruments. Time limit relays and oil-switches. Switchboards, motor-controlling panels. Circuit-breakers and lightning arresters. Direct and alternating-current motors. Direct and alternating-current generators. Static transformers. Automatic voltage regulators. Magnetite arc lamp. Alternating and direct-current enclosed arc lamps. Mercury arc lamps. Magnetic starting device for mercury arc lamps. Mercury arc rectifier. Railway motors and controllers. Mining locomotives. Searchlight and method of control. Progress and development in the art.



MERIDIAN LAMPS, PORTLAND EXPOSITION.

NIGHT SCENE, EDISON LAMPS, PORTLAND EXPOSITION.

For its new metallized carbon filament incandescent lamps, the company also received a gold medal.

This exposition, in common with all the recent American expositions, was lighted by Edison incandescent lamps, furnished by the General Electric Company. A unique feature was the extended use of Meridian lamps as indicated in the illustrations.

The Coal-Conveying Plant of the Hartford Rubber Works, Hartford, Ct.

The illustration herewith shows a belt conveyer installed by the Robins Conveying Belt Company, of New York, at the plant of the Hartford Rubber Works, Hartford, Ct. This conveyer takes coal from a track hopper, elevates it, and, by means of an automatic, self-reversing tripper, puts it in open storage along the line of the conveyer. A concrete pit was built underneath the railroad siding, and in this pit was installed a track hopper which delivered the coal to the conveyer which is eighteen inches wide and 255 feet between centres. During the first part of its run the conveyer is inclined at an angle of twenty-two degrees until it reaches a height of twenty-three feet above the ground. From that point on the conveyer is inclined at an angle of five and one-half degrees, and along this part of its run operates the tripper mentioned above. The operation of the tripper is entirely automatic, requiring no attention, moving back and forth along the run of the conveyer, discharging coal into the storage pile at every point. The drive used is a fifteen-horse-power motor belted to the driven pulley of the conveyer at the upper end.

COAL-CONVEYING PLANT OF THE HARTFORD RUBBER WORKS, HARTFORD, CT.

The entire installation is exposed to the weather, with the exception of the drive house which is enclosed and into which the tripper is run when not in operation.

Both anthracite and bituminous coals are handled by the conveyer. There is a grating in the track hopper on which the coal falls from the car, the anthracite coal passing at once through this grating to the belt. The fine portions of the bituminous coal fall through in like manner, but the larger pieces are caught on the grating, where they are broken by hand to a size which permits their passing through to the belt. Since the amount of bituminous coal handled is comparatively small, this "grizzly" does away with the need of a crusher installation which would be much more expensive. The grating also permits the use of a small belt conveyer, since the size of belt conveyers varies with the size of the coal handled.

Coal is reclaimed from storage by means of an industrial railroad and taken to the boiler house.

Orders for Water-Wheels.

The Abner Doble Company, San Francisco, Cal., has recently received several interesting orders for Doble tangential water-wheels. Prominent among them is an order from the California Gas and Electric Corporation for a 9,000-horse-power wheel for its de Sabla power plant. This machine will be similar to the 8,000-horse-power Doble wheel installed in the de Sabla plant last year, and the three 8,000-horse-power Doble wheels recently completed and now successfully operating in the new Electra station of the same company. The wheel will operate under a head of 1,530 feet at 400 revolutions per minute, and will be driven by a single jet of water, thus making it the most powerful water-wheel ever constructed for operation under a single jet of water. Another order from the California Gas and Electric Corporation calls for six 570-horse-power wheels for its Nevada City plant. These will operate under a 190-foot head at 410 revolutions per minute.

A 400-horse-power Doble wheel for operation under a 400-foot head, equipped with jet deflector operated by a Woodward compensating governor, has been shipped to the Chancellor Gold Mining Company, Wenatchee, Wash. The La Grande Water Storage Company, La Grande, Ore., has purchased an 800-horse-power, 1,150-foot head, 600 revolutions per minute Doble wheel, equipped with a Doble needle regulating nozzle for operation by a Lombard governor. Among other recent orders secured by the Abner Doble Company are two double 1,750-horse-power wheels for the San Joaquin Power Company, Fresno, Cal., for operation under 385-foot head; one Doble needle regulating nozzle for a large water-wheel for the Komata Reefs Gold Mining Company, New Zealand, and a double 700-horse-power water-wheel unit for Mitsui & Company, Japan, for operation under 210-foot head, this order including the wheel complete with Lombard governor and gate valve.

A Model Residential Lighting and Power Plant.

At the new summer home of Mr. William B. Blackwell, just outside of Morristown, N. J., there will shortly be installed a very complete and interesting electrical equipment which will serve to generate and supply electricity for a number of different purposes.

In considering the problem of providing suitable means of lighting his house, stable and farm buildings, Mr. Blackwell found it decidedly to his advantage to install an equipment for the generation of such electrical energy as he might require, and toward this end he has had one of the most complete and interesting isolated power plants designed, and this is now in process of construction. The electrical energy will be used for lighting of the buildings and grounds, as well as for power purposes in the farm buildings. The current will also be used for heating one of the rooms in the stable which can not conveniently be heated in any other manner without involving hazardous risks from fire, thus making the insurance rate on that building excessively high.

The electrical current will be generated by a direct-current electric generator, directly connected with a Secor oil engine. In addition to this generating set there will be a storage battery equipment consisting of sixty-two cells, which will be furnished by the General Storage Battery Company. The switchboard arrangement, which has been provided in connection with this generating set and storage battery, permits of three combinations for supply of current as follows: first, the battery alone feeding the line; second, the battery on charge and at the same time feeding the line; third, the generator and battery feeding the line in parallel.

An interesting feature of this equipment is the method of voltage regulation and control which has been designed and which includes a Chapman voltage regulator of the independent type.

This regulator is designed for regulating the terminal voltage and will maintain the voltage impressed on the line within one per cent of the voltage which would be indicated by a straight line from 110 volts at no load to 113 1-3 volts at full load of the generator under varying conditions of load and battery potential included in the above enumerated conditions of operation. Mr. Putnam A. Bates, consulting electrical engineer, was employed to design and arrange for the installation of this equipment.

Included also in the electrical work at this country residence is the distribution system for the electrical current for light and power for the various buildings, and also a private telephone system placing all of the buildings in intercommunication.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

NEW YORK TELEPHONE COMPANY INCREASES ITS SWITCHBOARD CAPACITY—Early in March, 1906, the New York Telephone Company will establish a new exchange district, to be known as "Rector." It will take in the southern half of the exchange district now designated as "Cortlandt." To make this change the company will increase its switchboard capacity in the Dey street building by accommodations for about 10,000 telephones. At present this building has a switchboard capacity of 10,000, and the new installation will double this. For several months an extensive addition to the Dey street building has been under construction, and the new building will soon be completed. The company has announced a new schedule of discounts on charges for messages between the various boroughs.

INTERURBAN LINE FROM EVERETT TO SEATTLE, WASH.—A trust deed has been filed in Seattle by the Colonial Trust Company, of New York, covering a mortgage of $1,500,000 for an interurban line between Everett and Seattle, Wash. The Everett-Seattle line is a part of a general scheme of electrification which has been under consideration for some time. It includes lines into the Cherry valley country, and as far north as Bellingham. A franchise for the use of the county roads has been secured from Snohomish County through the Kings County line to Skagit. The bond just filed covers the construction of the first section of the road, to be built at once from Everett to Seattle by a direct line *via* Silver Lake. It is understood that later on a branch will be built from Renton, on lake Washington, to Falls City, on the Snoqualmie river, thence north to Toalt, and thence through the rich Cherry valley to Monroe. From Monroe a branch line will run to Granite Falls, and the main line will come on to Snohomish and Everett. Everett will be the location for the roundhouse, workshops, and later on for the power-house. It is planned by the operating company—the Silver Lake Syndicate—to spend at least $5,000,000 on the entire system between Seattle and Mount Vernon and Bellingham.

EXTENSIVE POWER PLANT NEAR CHATTANOOGA, TENN.—Contractors will begin work at once on a $3,000,000 power plant on the Tennessee river, about twelve miles from Chattanooga, Tenn. The Chattanooga & Tennessee River Power Company is to build the plant. C. E. James and J. C. Guild are at the head of the enterprise, and John Bogart, of New York, is consulting engineer. This will be the first power plant of the kind that the United States government has allowed to be built on a navigable river. The Tennessee river is 1,200 feet wide where the dam is to be built. The engineers at the head of the enterprise, however, have made arrangements to build a lake, so that the dam will in no way obstruct navigation. It will make thirty-six miles of slack water, turning the river almost into a lake. About two years ago a special bill was put through Congress, through the efforts of Mr. James and Mr. Guild. The offer of the company to defray all the cost of constructing the lake and to improve existing conditions was such that a ready acceptance was possible. The total capacity of the plant will be 56,000 horse-power. Fourteen generators, each of 4,000 horse-power capacity, will constitute the generating equipment. The power will be transmitted to Chattanooga, and it is estimated that there will be something like 800 establishments that will buy current from the company.

STREET RAILWAY COMPANY ORGANIZED TO SUPPLEMENT HUDSON RIVER TUNNELS—The Hudson Street Railroad Company has filed articles of incorporation in Jersey City, N. J. The capital stock is $3,000,000, and the object of the company, as given in the papers, is to construct and operate street railway lines in Hudson County. The following directors have been elected: Pliny Fisk and William M. Barnum, members of the banking house of Harvey Fisk & Sons; Walter G. Oakman, president of the Hudson companies, which are building the tunnels between Jersey City and New York; William McAdoo, president of the Hudson & Manhattan Railroad Company; Andrew Freedman, director of the Interborough Rapid Transit Company; David Young, of Newark, a former official of the North Jersey Railroad Company. The following officers were elected by the directors: president, William G. McAdoo; vice-president, Andrew Freedman; secretary, K. B. Conger; treasurer, William C. Kinney. President McAdoo gave out the following statement concerning the new company: "The Hudson Street Railway Company was organized for the purpose of increasing and improving the local transportation facilities throughout the principal cities and towns of Hudson County, with a view to operating these lines in connection with the tunnels now being built under the Hudson river. The new lines are so planned as to tap the tunnels back from the water front, so that fast time can be made through the congested business districts in Jersey City and Hoboken; and this, coupled with the fact that the new lines will have superior track construction and most modern equipments, will result in reducing the time between the residential and business districts of New York and New Jersey to practically one-half of that now required to get across the river."

EDUCATIONAL.

UNIVERSITY OF CHICAGO—The first issue of the "Journal of Engineering" of the University of Colorado, Boulder, Col., has been issued. This is to be the organ of the associate engineering societies of the university, these societies being the civil engineering society, the electrical engineering society, and the mechanical and chemical engineering society. The issue contains a number of interesting articles, those pertaining to electrical engineering being "Multiple Voltage Speed Control for Motor-Driven Machine Tools," By Lucius I. Wightman; "The Differential Telephone," by Charles A. Lory and Claude C. Coffin; "Compounding of Rotary Converters," by J. L. Burnham; "An Insulator Test," by S. D. Coffin; "A Large Electromagnet for Optical and Surgical Work," by H. E. Sovereign.

THE POLYTECHNIC ENGINEER—The "Polytechnic Engineer," the annual organ of the engineering society of the College of Arts and Engineering of the Polytechnic Institute of Brooklyn, for 1904-1905, has been received. This contains the following interesting contributions: "Obstructance and Obstructivity," by Dr. Samuel Sheldon; "A Standard System of Multiple Voltage," by Oskytel H. Clarke; "An Innovation in Technical Education," Walter I. Tamlyn; "On the Problem of the Plane Sound Wave in Air," William J. Berry; "The Manufacture of Steel in the Electric Furnace," Rolin W. Hutchinson; "The Test at the Central Brewery," William B. Kouenhoven; "The Steam Turbine," E. Lurnan Mills; "The Four-Cylinder Balanced Compound Locomotive," J. Melin Wiley; "The Summer Survey," Frederick Ljung.

PERSONAL MENTION.

MR. LOUIS V. FRENCH has been appointed superintendent of the Ashtabula (Ohio) interests of the Bell Telephone Company.

MR. MYRON DAVIS, manager of the Cambria County Telephone and Telegraph Company, at Cresson, Pa., has resigned his position to accept the superintendency of the Indiana Telephone Company, at Indiana, Pa.

MR. WILLIAM L. HASKINS, formerly with the American Telephone and Telegraph Company at Pittsburg, has taken charge of the mechanical department of the Pennsylvania Telephone Company of Wilkesbarre and vicinity.

MR. W. H. JACOB, of the Triumph Electric Company, Cincinnati, Ohio, was a visitor to Chicago last week. Mr. Jacob reports a very favorable condition of trade with the Triumph company, and anticipates an extremely busy winter.

MR. M. F. BOWLER has been appointed manager of the Waterbury (Ct.) office of the Western Union Telegraph Company, to succeed Charles H. Stancliff. Mr. Bowler entered the service of the company at New Haven in 1885. In 1893 he became an operator, going to Waterbury in 1896.

MR. WARREN F. HUBLEY has resigned his position with the Sunbeam Incandescent Lamp Company, Philadelphia, Pa., to accept the position of western representative of the American Trans-

former Company, of Newark, N. J. His headquarters are now with the Western Electric Company, Chicago, Ill.

MR. CHARLES J. GLIDDEN lectured at the Automobile Club of America, New York city, on Monday evening, October 23, giving his experiences in "Touring the World in a Motor Car; the Southern Hemisphere, Fiji, New Zealand, Tasmania, Australia and Java." The lecture was illustrated by several hundred lantern slides. Mr. Glidden sailed on the following day to continue his around-the-world tour.

MR. T. K. WELLS has been appointed superintendent of transportation of the Manila Electric Railway and Lighting Company, Manila, P. I. This road is controlled and operated by J. G. White & Company. Mr. Wells has had a wide experience in railroad work, having been with the Wabash Railroad and the St. Louis, Iron Mountain & Southern Railroad for fourteen years, and with the Syracuse Rapid Transit Company for eight years.

MR. HARRY H. HORNSBY, who succeeds Alexander Henderson as sales manager of the conduit department of the Sprague Electric Company, New York city, has had many years' experience in the electrical business, both in the East and in the West. While chief inspector of the department of electricity in the city of Chicago he did much to improve the standard of electrical protection. He resigned the position of chief inspector to become sales engineer of the conduit department of the Sprague Electric Company, which position he has held until his present advancement. Mr. Hornsby has recently passed through a severe illness, and his many friends will be pleased to know that he is rapidly recovering his usual good health.

MR. PHILIP P. BARTON has been appointed general manager of the business and operation of the Niagara Falls Power Company and of the Canadian Niagara Power Company. The appointment also includes that of general manager of the Niagara Junction Railway Company and of the Niagara Development Company. Mr. Barton graduated from Cornell University in 1886, with the degree of Ph. B. After two years of post-graduate work in electrical engineering he received, in 1888, the degree of M. S. from the same institution. He began his professional career in the electrical department of the Cambria Iron Company, at Johnstown, Pa. After several months of practical work there and with the Allegheny Light Company, of Pittsburg, Pa., he joined the engineering force of the Westinghouse Electric and Manufacturing Company. He was for some years engaged in installing electric lighting and power plants in various parts of the country, mainly in the South and in the West. In 1892 he entered the service of the Brush Electric Company, of Cleveland, Ohio, in charge of engineering and sales at its Pittsburg office. After the closing of that office in February, 1898, he was connected for some years with the Pittsburg office of the General Electric Company. In September, 1898, he became assistant superintendent of the Niagara Falls Power Company, at Niagara Falls, and two years later was made superintendent of the operating department of the company. In July, 1905, he was appointed superintendent of operation of the Niagara Falls Power Company and of the Canadian Niagara Power Company, which positions he has held until his present appointment. Mr. Barton is an active member of the American Institute of Electrical Engineers.

MR. P. P. BARTON.

ELECTRICAL SECURITIES.

While the earlier sessions of the week proved dull and irregular, following the apathetic conditions which have prevailed for several weeks, the closing sessions were animated beyond the predictions of even the most sanguine. In many quarters it is predicted that the autumn bull movement is now on, and that an upward tendency will be the governing factor until after the holidays. The money outlook has been materially improved, and the excess of exports over imports for September, as well as for the eight months preceding, is in line with the tendency which bids for advancing prosperity. For nine months of the present year the imports made a high record, with a total of $872,548,988, as against $751,394,339 last year. Exports for the nine months reached a total of $1,102,575,831, as against $985,486,881 for last year.

ELECTRICAL SECURITIES FOR THE WEEK ENDING OCTOBER 21.

New York:	*Closing.*
Brooklyn Rapid Transit	78⅜
Consolidated Gas	186
General Electric	183¾
Interborough Rapid Transit	212½
Kings County Electric	200
Manhattan Elevated	166
Metropolitan Street Railway	127
New York & New Jersey Telephone	167
Westinghouse Manufacturing Company	190

At the meeting of Western Union directors, the board organized by reelecting the old officers. The executive committee met and reelected the same subcommittees.

The General Electric Company is said to be doing the heaviest volume of business in its history at the present time. The demand for electrical apparatus of almost all descriptions has been unprecedented during the past few months.

The annual report of the Manhattan Railway Company for the year ended June 30, 1905, is as follows: gross, $13,198,292; expenses, $5,546,937; net, $7,651,355; other income, $309,552, a total of $7,960,907; charges, taxes, etc., $7,009,514, leaving a surplus of $951,393, as compared with $1,925,724 for the preceding year, a decrease of 7 per cent. As the management had expected a decrease of 20 per cent, the actual figures were considered very favorable. The increase in cost of operating from 41.2 per cent to 48.03 per cent was largely due to an increase in wages and the severe storms of last winter. It is expected that the earnings this year will at least equal those of 1904.

The State Gas and Electricity Commission has received an application from the Kings County Electric Light and Power Company for permission to issue additional capital stock to the amount of $5,000,000. A hearing on the application will be given about November 17 in New York city.

Boston:	*Closing.*
American Telephone and Telegraph	137¾
Edison Electric Illuminating	249
Massachusetts Electric	56
New England Telephone	138
Western Telephone and Telegraph preferred	90

The American Telephone and Telegraph Company reports the net output of instruments for the month of September at 109,119, against 67,954 for the corresponding period of 1904, an increase of 41,167. From January 1 to September 30 the net output was 843,653, against 501,684 in 1904, an increase of 341,969. The total number of instruments now outstanding is 5,324,217, as compared with 4,281,201 last year, a gain of 1,043,016. Coupons from the five per cent three-year gold coupon notes of the company, by their terms payable on November 1 at the office of the treasurer in the city of New York, or at the holder's option, at the office of the treasurer in the city of Boston, will be paid in New York by the Manhattan Trust Company, or in Boston by the National Bank of Commerce.

Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	85
Electric Storage Battery preferred	85
Philadelphia Electric	8⅝
Philadelphia Rapid Transit	27½
United Gas Improvement	94

Chicago:	*Closing.*
Chicago Telephone	137
Chicago Edison Light	163
Metropolitan Elevated preferred	71
National Carbon common	62¼
National Carbon preferred	115⅝
Union Traction common	12
Union Traction preferred	37

Directors of the Chicago Edison Company have declared the regular 2 per cent quarterly dividend, payable November 1.

President Parmalee, of National Carbon, says the question of another dividend on the common will not be considered until the end of the fiscal year.

Reports that Chicago Telephone will increase its dividends are denied by officials. Since January 1 the company has extended its business by 19,000 telephones, and has now in operation 135,494 instruments.

NEW INCORPORATIONS.

SEATTLE, WASH.—Waterville & Columbia River Railway Company. $1,200,000.

KEENE, N. H.—Citizens' Electric Company. Increased from $35,000 to $50,000.

ST. PAUL, MINN.—Norman County Telephone Company. Increased to $12,500.

LINCOLN, NEB.—Steinauer Telephone Company. Increased from $3,000 to $25,000.

DES MOINES, IOWA—Farmers and Merchants' Mutual Telephone Company, Cincinnati. $10,000.

NEW CASTLE, ARK.—New Castle Telephone Company. To construct a line from New Castle to Forrest City. $1,700.

LITTLE ROCK, ARK.—The Mena Light, Heat and Power Company, Mena. $250,000, of which $125,000 is subscribed and paid in.

ALBANY, N. Y.—Rome & Oneida Electric Railway. $350,000. Incorporators: Charles Jackson, I. L. Hill, M. D.; Louis Mendelson, New York city.

BIRMINGHAM, ALA.—Haynesville & Montgomery Railroad Company. $50,000. Incorporators: G. E. McGehee, Charles Schuessler and W. G. Davis.

BELLEVILLE, MO.—Collinsville Gas, Electric and Refrigerator Company. $50,000. Incorporators: Charles E. Slocum, John H. Seigel and W. E. Hadley.

LITTLE ROCK, ARK.—Boonesboro & Stillwell Telephone Company. Changed to Cane Hill & Stillwell Telephone Company, and capital increased to $10,000.

ALBANY, N. Y.—Home Telephone Company, Ellicottville, Cattaraugus County. $10,000. Directors: T. S. Lane, Jamestown; W. B. Page, F. B. Keith, Ellicottville.

SPRINGFIELD, ILL.—Kewanee Long-Distance Telephone and Telegraph Company. $100,000. Incorporators. W. I. Hibbs, Frank M. Ashe and A. C. Shoemaker.

CAMDEN, N. J.—The Southern Telephone Developing Company. $100,000. Incorporators: John T. Landis, Lulon Landis, J. Ray Boone and George H. B. Martin.

CHICAGO, ILL.—Postal Telegraph-Cable Company, Chicago. To operate a system of telegraph. $25,000. Incorporators: Edward J. Nally, Frank J. Loesch, James Stillwell.

SOUTH BEND, WASH.—Chinook Light, Power and Water Company. $10,000. Incorporators: James K. Pollock and J. G. Kelly, of Portland, and Albion L. Gile, of Chinook.

COLUMBUS, OHIO—The Northwestern Mutual Telephone Company, Elmira, Fulton County. $10,000. Incorporators: J. H. Ferrel, J. F. Reeves, G. R. Shafer, Joel Wyse and Henry Keller.

ALBANY, N. Y.—The Electrical Developing Company, of Amsterdam. $4,000. Directors: John W. Mead, Harry A. Mackie, William P. McGeough and William H. Terwilliger, of Amsterdam.

HARTFORD, CT.—Trolley Express Company of New Haven. To carry merchandise over various trolley lines. $100,000. Incorporators: Charles E. Mellen, E. G. Buckland and Calvert Townley.

DOVER, DEL.—Arrow Head Reservoir and Power Company, of Los Angeles, Cal. $6,000,000. Incorporators: John D. Work, F. E. Trask, F. C. Finkle, Los Angeles; Victor C. Smith, San Bernardino.

SPRINGFIELD, ILL.—Cairo & Thebes Railroad Company. $10,000. Incorporators and directors: Egbert A. Smith, William J. Johnson, Daniel Hartman, George J. Becker and James H. Calligan, all of Cairo.

NEW YORK, N. Y.—The Manhattan & Long Island Railroad Company, New York. To operate an electric road, eighty miles long, in Greater New York and on Long Island, the terminals to be in Long Island City and at Northport. $10,000,000.

INDIANAPOLIS, IND.—Wabash & Northern Traction Company. To connect the towns of North Manchester, Rose Hill, Silver Lake, Claypool and Warsaw. $50,000. Directors: Joseph A. Barry, Lincoln Guyn, Lawrence L. Daugherty, Ed L. Schmock and Willard J. Fitton.

LEWISTON, ME.—Palermo Telephone Company. For the purpose of constructing and operating telephone lines from Palermo to China, Albion, Somerville, Hibert's Gore and Liberty. $5,000. Officers: president, Silas E. Bowler, of Palermo; treasurer, W. W. Turner, of Palermo.

ALBANY, N. Y.—The Broadalbin Electric Light and Power Company. To supply the towns of Broadalbin and Mayfield, Fulton County, and Providence, Saratoga County, with light and power. $50,000. Directors: William Pierson Judson, Henry C. Finch, Anna L. Judson and Lottie A. Finch, of Broadalbin.

SPRINGFIELD, ILL.—The Atlanta & Lawndale Railroad Company. To construct a line from Atlanta, Logan County, in a southerly direction to a point near Lawndale. $25,000. Incorporators and first board of directors: James Miles, Riverside; Silas Strawn, Ralph M. Shaw, John D. Block and Edward W. Everett, all of Chicago.

SALT LAKE CITY, UTAH—The Eastern Utah Telephone Company, Price, Carbon County. $50,000. Directors: Reuben G. Miller, president; A. McGoverney, vice-president; Arthur W. Horsley, Albert Bryner, F. F. Fisk, R. W. Crockett, J. W. Nixon and George Y. Wallace. The last named is president of the Rocky Mountain Bell Telephone Company.

COLUMBUS, OHIO—Nelsonville, Athens & Gloucester Traction Company. To build a new electric line from Nelsonville through Buchtel, Murray City, Gloucester, Trimble, Jacksonville, Chancey, Sugar Creek to Athens and back to Nelsonville by way of Doanville. $10,000. Incorporators: L. F. Carpenter, J. P. Reynolds, T. E. Wells, W. J. Stuart, B. C. Wise, Charles Tutt.

PITTSBURG, PA.—Gallitzin Borough, the Gallitzin, Portage & Wilmore, the Gallitzin, Cresson & Wilmore and the Gallitzin, Lilly & Wilmore Street Railway companies, with a combined capital of $93,000. To build eighteen miles of road in Cambria County. Directors: J. Toner Barr, president, and Frederick J. Fisher, J. I. Mullin, C. W. Mositer and Jacob Link, all of Pittsburg.

NASHVILLE, TENN.—Union City & Reelfoot Railway Company, Obion County. $100,000. Incorporators: R. P. Whitesell, J. C. Burdock, T. B. Greer, A. E. Darrah, W. M. Turner, C. P. Wilson, John White, F. M. McCree, John Thaw, H. C. Sanfield and J. C. Reynolds. The company proposes to construct, equip and operate a line from Union City, in Obion County, to Tiptonville, in Lake County.

ALBANY, N. Y.—The Great Eastern Telegraph Company, of New York city. To operate in and between New York, Albany, Syracuse, Rochester, Buffalo and other cities and villages of the state, and connect with other companies' lines. $1,000,000. Directors: William H. Schack, Eugene H. Brock, Elias J. Beach, Egbert A. Reynolds, D. A. Reynolds, W. Myron Reynolds, of New York city, and Stephen M. Conger, of Brooklyn.

SAN FRANCISCO, CAL.—Sacramento & Lake Tahoe Railway Company. To build an electric line through Folsom and Placerville, 125 miles long, with a branch line about forty miles in length to connect the main line with Newcastle and Auburn. $7,500,000. Incorporators: B. G. Raybould, W. S. Graham, of Auburn; Leo Alexander, Thomas H. Nicholls, James H. Swift, T. Otway Sadlier, Edward F. Haas, John A. Black and Charles Wesley Reed.

HARRISBURG, PA.—Brownsville Street Railway Company; $24,000; president, Holman H. Lynn, Pittsburg. Bridgeport Street Railway Company; $24,000; president, Holman H. Lynn, Pittsburg. Freedom & Baden Street Railway Company; $6,000; president, John H. Park, Beaver. Economy & Harmony Streets Railway Company; $18,000; president, William A. Park, Rochester. Ambridge & Baden Street Railway Company; $12,000; president, W. E. Guy, Pittsburg.

JACKSON, MISS.—Mississippi Telegraph Company. For the purpose of building a telegraph line, commencing at Jackson and running along the Alabama and Vicksburg road through the counties of Rankin, Scott, Newton and Lauderdale, to the city of Meridian, thence northerly along the line of the Mobile & Ohio road through the counties of Lauderdale, Kemper, Noxubee and Clay, to the city of West Point. $25,000. Incorporators: Fred Clark, W. T. Townsend and others.

ELECTRIC RAILWAYS.

DENISON, TEX.—A franchise has been granted James L. Shuler, a citizen of Durant, for a system of street cars in that city.

PERU, IND.—Through service from Fort Wayne to Lima, Ohio, over the Fort Wayne, Van Wert & Lima electric line, has been started.

BIRMINGHAM, ALA.—The contract has been let for the construction of the Atlantic, Birmingham & Atlantic line from La Grange, Ga., to Talladega, Ala.

PEKIN, ILL.—The village board of Tremont has granted a fifty-year franchise to the Bloomington, Pekin & Peoria Interurban Railway Company, to maintain and operate an electric railway in and through that city.

BOYERTOWN, PA.—The petition for a franchise for the Boyertown & Palm Trolley Company has been granted, with the provision that the company commence work on the new road within a month and complete the same in one year.

TOLEDO, OHIO—Surveyors have nearly completed running the line for the Genoa-Toledo end of the Toledo, Port Clinton & Lakeside line, and it is hoped to finish the work by January 1. Cars are now being run from Port Clinton to Marblehead.

COLUMBUS, OHIO—Official information has been received in Columbus of the purchase of the Columbus, Buckeye Lake & Newark, and the Columbus, Newark & Zanesville electric roads by the Widener-Elkins syndicate of Philadelphia. The deal for the purchase of the Appleyard interurban roads has not been closed.

BARABOO, WIS.—The project of building an electric road from Kilbourn to Devil's lake by the way of Baraboo, which has been dormant for several years, has been revived and the prospects are that the line will be built in the near future. The Dells Company, at Kilbourn, is willing to furnish the greater part of the money for the proposed road.

BUZZARDS BAY, MASS.—Plans for extending the Plymouth and Sandwich street railroad line from where the road now ends, near Fresh Pond, to Sagamore, and connecting it by a loop with the Middleboro, Wareham & Buzzards Bay line at the four corners in Bourne, are being completed. The line will, it is said, be in operation next summer.

LOWELL, MASS.—The Woburn city council has voted to grant the petition of Joshua M. Sears and others, asking for authority to connect the tracks of the Lowell & Woburn street railroad on Winn street with those of the Boston & Northern railroad on Pleasant street. The council also granted the Lowell & Woburn road the right to tap the power wires of the Boston & Northern road on Main, Lowell and Wyman streets.

EAST LIVERPOOL, OHIO—The East Liverpool Traction and Light Company has taken charge of the property of the United Power Company and the East Liverpool & Wellsville Electric Railway Company. L. W. Healy, manager and chief owner of these properties, is succeeded by Edward McDonnell, of Buffalo, as general manager. The company proposes to rebuild and double track the main line from East Liverpool to Wellsville at once.

SPRINGFIELD, MASS.—It is said that New York state capitalists are projecting an electric railway line to extend from Albany, N. Y., through the Berkshire hills to Chester and Northampton. Some use, it is thought, might be made of an old charter which was granted thirty-one years ago to the Boston, Hoosac Tunnel & Albany Railroad Company. The estimated cost is $2,000,000, and the proposed name of the company is the Albany & Eastern Electric Railway Company.

TOMPKINSVILLE, N. Y.—Extensive improvements are being made to the Staten Island Rapid Transit Company's properties. They consist of putting down eighty-five pound rails, ballasting the system with stone, building a large stone dock 485 feet long by fifty-one feet wide, extensions of other docks, installation of car unloaders and the construction of a foreign freight pier at Tompkinsville. The New York State Construction Company has contracts for the dock work and the General Contracting and Engineering Company a lighterage pier and docks at St. George. The contract for the Tompkinsville pier will be awarded shortly. This work will cost about $200,000.

TELEPHONE AND TELEGRAPH.

GREENSBORO, N. C.—The Bell Telephone Company will erect another line from High Point to Greensboro.

IOLA, KAN.—The Missouri & Kansas Telephone Company has begun work on the rebuilding of its local plant.

ALPENA, MICH.—The Michigan State Telephone Company has leased an office at Quincy and opened an exchange.

WATERVILLE, ME.—The Somerset Farmers' Cooperative Telephone Company will build a line from Skowhegan to Lakewood.

STERLING, ILL.—The work of reconstructing the Bell Telephone Company's system has been completed at a total cost of $10,000.

YPSILANTI, MICH.—The council has accepted the proposal of the Michigan State Telephone Company to place its wires underground.

STARKVILLE, TENN.—The Starkville Power and Telephone Company has sold its local system to the Cumberland Telephone Company.

READING, PA.—A new line has been erected from Hereford to Siesholtzville, and preparations are being made for a circuit from Pennsburg to Hoppenville.

FLORENCE, COL.—The Colorado Telephone Company will extend its line from Florence to Querida, Custer County, by way of Wetmore, a farming section.

HUNTINGDON, TENN.—The citizens of Newbill have organized an independent telephone company. They will erect a line from Newbill to Huntingdon, connecting with the Cumberland Company.

HANNIBAL, MO.—The Bluff City Telephone Company has elected these officers: president, J. F. Davidson; vice-president, T. G. Dulong; treasurer, J. P. Hinton; secretary and general manager, H. G. Conger.

CARLETON, MICH.—The People's Telephone Company, of Wayne, has completed a new rural line to Flat Rock, with twenty additional subscribers. A new four-mile rural line is also to be erected from Carleton to Ash Center.

PHILADELPHIA, PA.—At the annual meeting of the Philadelphia, Reading & Pottsville Telegraph Company, at Reading, the officers and directors were reelected. All the stock of the company is owned by the Reading Company.

KAUKAUNA, WIS.—Work upon the new toll lines which the Fox River Valley Telephone Company is building between Green Bay and Appleton has been delayed on account of the non-arrival of poles. The company already has connections between Green Bay and De Pere and between Appleton and Kaukauna, and less than a month will be required to close the intervening gap.

LAFAYETTE, IND.—The stockholders of the Lafayette Telephone Company at their annual meeting elected the following directors: William Folckemer, William Horn, Sr., Leopold Dryfus, George P. Haywood, Edgar A. Taylor, Richard B. Sample, William S. Baugh, Henry A. Taylor, and O. P. Friberg. The directors then reelected the following officers: president, William Folckemer; vice-president, William Horn, Sr.; secretary, O. P. Friberg; treasurer, Henry A. Taylor.

IOWA FALLS, IOWA—The Central Iowa Telephone Company, which has its headquarters in Iowa Falls, is building an extensive line north to connect Clarion with its system. This line will give the Wright County seat direct connections with Hampton, Iowa Falls, Waterloo, Fort Dodge and other points in northern and central Iowa that has been denied since last spring when the Bell Company cut out these connections. An exchange will also likely be started in Clarion.

MARION, IND.—There has been formed in this city a new combination of independent telephone interests, including the Converse Telephone Company, Winchester Telephone Company, Delaware & Madison Telephone Company, of Muncie, and the Home Telephone Company, of Fort Wayne. Officers were elected as follows: Thomas Bromley, Jr., of Muncie, president; L. T. Barger, of Converse, vice-president; O. L. Barger, of Converse, secretary and treasurer. The executive committee consists of the officers and J. E. Brown, of Winchester.

INDUSTRIAL ITEMS.

THE ELECTRO-DYNAMIC COMPANY, Bayonne, N. J., has issued a series of new bulletins descriptive of the "Interpole" variable-speed motor.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., in bulletin No. 409 describes and illustrates switchboards for small direct-current plants.

THE A. N. KELLOGG NEWSPAPER COMPANY, 91 West Adams street, Chicago, Ill., has published a handsome booklet, listing 1,921 family weekly newspapers in this company's service.

THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, 110 Woodford street, Plainville, Ct., is calling attention to its plug cutouts. An attractive advertising folder illustrates and describes the various features of these cutouts.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing the November issue of "Graphite." This contains considerable interesting data relating to mechanical engineering operations and the use of the Dixon company's graphite materials.

THE STERLING ELECTRICAL MANUFACTURING COMPANY, Warren, Ohio, distributes a regular monthly issue of the "Lamp-oon." This contains a considerable amount of light reading, and some sketches of a serious nature calling attention to the value of the "Sterling Special" lamp.

I. S. SPENCER'S SONS, INCORPORATED, Guilford, Ct., has issued a handsomely printed souvenir describing and illustrating the historical development and present extent of its works. The company has a very complete equipment for the manufacture of light grey iron and brass castings and general hardware.

THE FIDELITY INTERNATIONAL AGENCY, 621 Broadway, New York city, is the United States agent for Siemens & Halske, Berlin, Germany. Bulletins which have been issued recently describe and illustrate loud-speaking telephone sets, mine telegraph apparatus, and safety stop apparatus for hoisting engines.

THE CHANDLER & TAYLOR COMPANY, Indianapolis, Ind., has sold one of its standard service, enclosed self-oiling engines of the direct-connected type to the owners of the New York Life Building in Chicago. The company has also sold an engine of the same type, made tandem compound, to the University of Nebraska, Lincoln, Neb.

PATTERSON, GOTTFRIED & HUNTER, LIMITED, 146-150 Centre street, New York city, has issued catalogue No. 45 descriptive and illustrative of power transmission appliances. The lists include the various dimensions, the weights and prices of all parts, and a carefully arranged index makes it easy to discover any specific material.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., is again calling attention to the "P. & S." double-pole socket. The company claims that grounding is prevented, and that the socket has all of the beauty and service that can be crowded into so small a compass. The copper contact shell is also an important feature of the double-pole socket.

WILLIAM S. BRYAN, St. Louis, Mo., announces that the Breese (Ill.) Water and Light Company has decided not to attempt to get its new lighting plant in operation before Christmas, as originally intended. All of the bids received on the ninth of October have therefore been rejected, and new proposals are invited for 10 A. M., Monday, October 30. Mr. Bryan is consulting engineer, and Victor J. Klutho is architect.

THE GOLD CAR HEATING AND LIGHTING COMPANY, 17 Battery place, New York, is preparing an exhibit for the Madison Square Garden Electrical Show, to be held in New York city, from December 12 to December 23. This exhibit will exploit the uses of electricity for heating. Special demonstrations of electrical house heating will give the visitors a practical idea of the attractiveness of the modern form of electrical utilization.

THE CANADIAN WHITE COMPANY, LIMITED, has been awarded the contract for erecting at Hamilton, Ont., the new head office building for the Federal Life Assurance Company. Messrs. Finley & Spence, of Montreal, are the architects. This building will be an eight-story modern steel construction fireproof office building. The Canadian White Company has the entire contract, and will have the building ready for occupancy not later than August 1, 1906. The company has also been awarded the contract for the construction of the street car sheds for the Montreal Street Railway Company. Messrs. Marchand & Haskell are the architects.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, in Bulletin No. 10 describes and illustrates its electric mine locomotives, electric gathering locomotives, rack-rail locomotives and storage battery locomotives. In addition to the very complete descriptive matter there are illustrations of many of the parts. This is a particularly interesting bulletin; it is very well printed, and is worthy of careful reading and preservation.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has received an order from the South Side Elevated Railroad Company, of Chicago, Ill., for eighty complete double equipments, unit switch control, for the new No. 121 motor. These motors are rated at eighty-five horse-power each. The order calls for 160. This is in addition to a previous order from the same company received a short time ago.

THE NATIONAL CARBON COMPANY, Cleveland, Ohio, will have an extensive exhibit at the Madison Square Garden Electrical Show, to be held in New York city, from December 12 to December 23. A feature will be the exhibition of the recent improvement designated as its expansion pigtail brush attachment. The company will also exhibit a complete line of carbons for both wet and dry primary batteries. In addition the company will show a complete line of Columbia dry cells.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards for the following places: Sonora, Ky.; Minneapolis, Minn.; Moosminsaskhechewan, Northwest Territory; Pattersonville, N. Y.; Des Moines, Iowa; Seward, Ill.; Sublette, Ill.; Little Valley, N. Y.; Beloit, Kan.; Milbanke, S. D.; Wheeling, W. Va.; Linn Grove, Ind.; Brooten, Minn.; Abbott, Tex.; Vertrees, Ky.; Payette, Ida.; Hammonton, N. J.; Chenoa, Ill.; Tiskilwa, Ill.; Swedesboro, N. J.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., has issued a new series of attractive and interesting literature. Catalogue No. 123 deals with saw mill carriages and accessory machinery; bulletin No. 1402, the Allis-Chalmers steam-shovel; bulletin No. 1403, the Hancock jig; bulletin No. 1404, the McDougall roasting furnace; bulletin No. 1607, the high-duty horizontal, double-acting, crank and flywheel plunger pump, driven by cross-compound, Reynolds-Corliss engine; bulletin No. 1608, motor-driven, single-stage, centrifugal pumps.

C. H. M'GIEHAN & COMPANY, 11 Broadway, New York, has prepared a practical novelty in the form of a shop and office thermometer. The shop barometer is provided with a mounting upon which are printed decimal equivalents, in sixty-fourths. The office style is made up without this table. The company undertakes expert mechanical work, designing and draughting, and builds automatic and special machinery. While these thermometers are not intended for promiscuous distribution, they may be secured upon proper application to the company.

G. M. GEST, New York and Cincinnati, the expert subway contractor, has been awarded a contract for the construction of a complete electrical subway system for the Dayton Lighting Company, Dayton, Ohio. This plant has recently been acquired by new interests, and is being entirely rebuilt and reequipped. The contract given to Mr. Gest is for the subway installation for the whole city, covering twenty miles of streets, and involving over 1,000,000 feet of conduit. The system is to be absolutely modern and up to date, and the amount involved will be in the neighborhood of $250,000.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has issued a new series of very attractive flyers and bulletins. Flyer No. 2166 describes porcelain receptacles for moulding wiring. The test of a 2,000-kilowatt Curtis steam turbine is the subject of a handsomely printed brochure. Supply catalogue No. 7591 lists parts of edgewise parallel rod, 110-volt, direct-current, multiple enclosed arc lamps, forms 14 and 12. The luminous electric radiator is described and illustrated in a neat booklet, and a reprint of P. D. Wagoner's National Electric Light Association's paper on "Mercury Arc Rectifiers" is also included. Railway line material and railbonds are described and illustrated in a fine catalogue of eighty-four pages.